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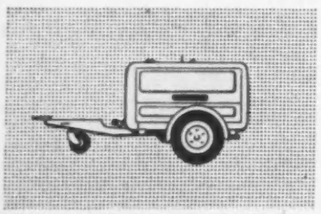
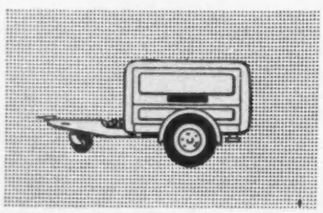
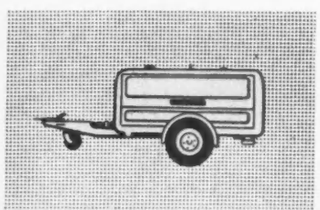


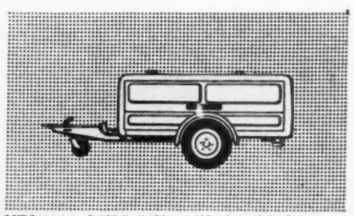
VT3 Weight 2,180 lb (990 kg) 115 c.f.m. (3.2m³/m)



VT4 Weight 2,310 lb (1050 kg) 160 c.f.m. (4.5m³/m)



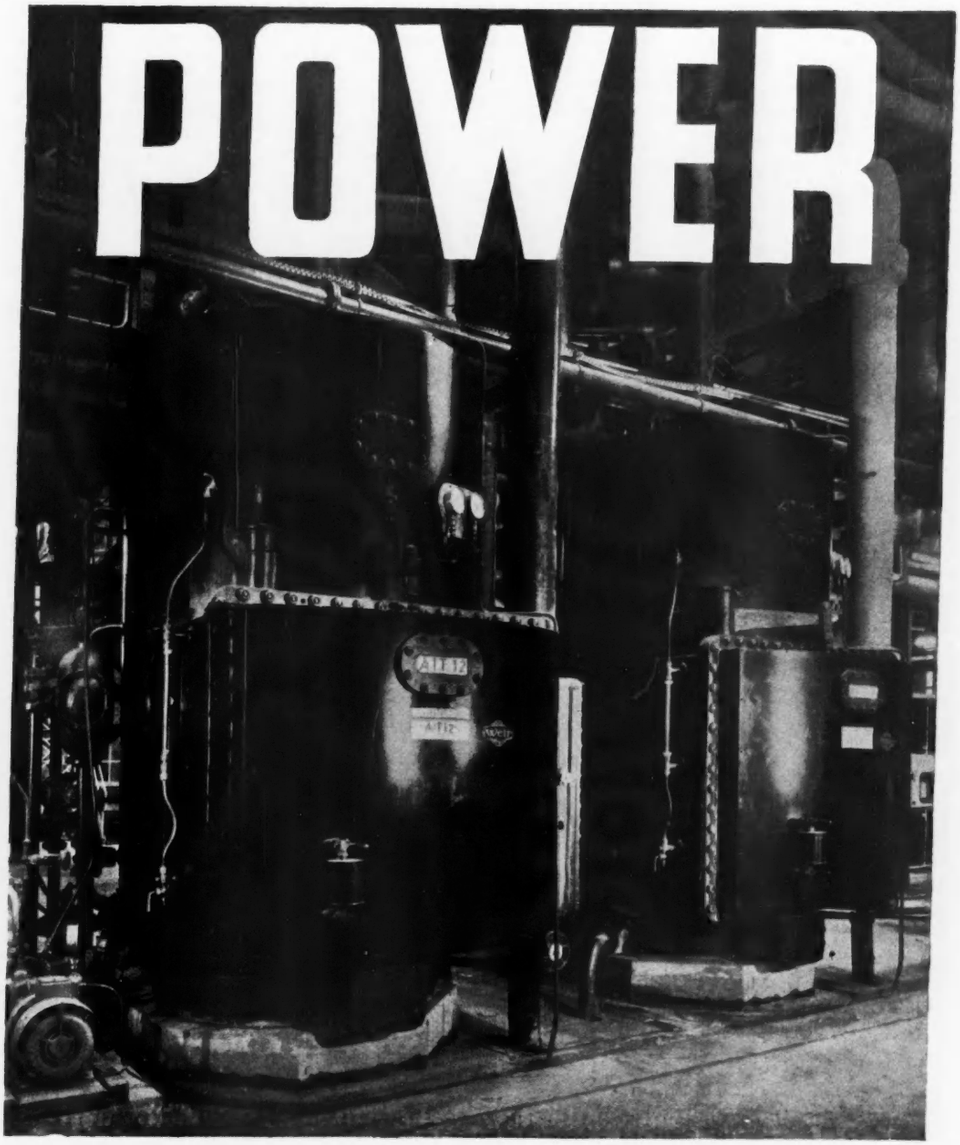
VT5 Weight 2,900 lb (1315 kg) 225 c.f.m. (6.4m³/m)



VT6 Weight 3,590 lb (1630 kg) 315 c.f.m. (8.9m³/m)

PCR1

POWER



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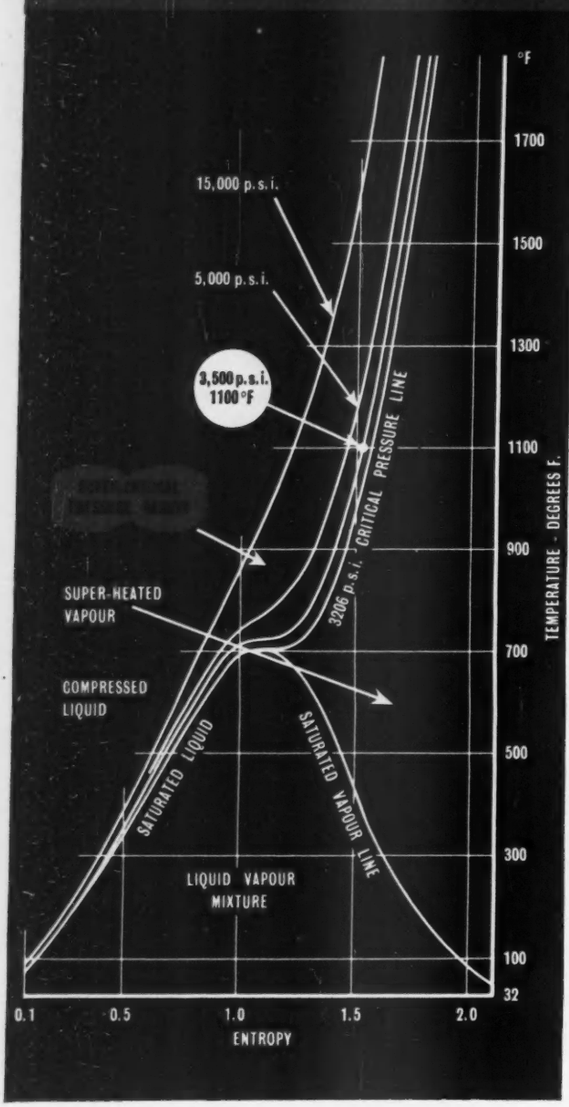

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26 August 1960

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Cover Picture

To such an extent has engineering assumed responsibility for food production, processing, distribution and presentation, that food supply has virtually become a branch of engineering. On the shelves of any modern grocer's shop can be seen food that has been mechanically harvested, transported in bulk, processed, packaged, canned or frozen before being offered to the customer, who, in buying it, follows a procedure borrowed from the work-study engineer.

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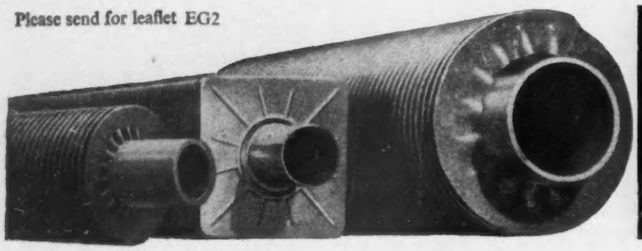

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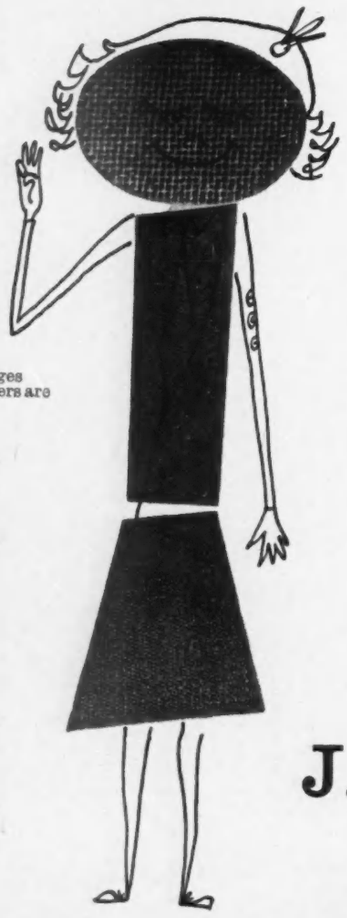

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UNIVERSITY OF MANCHESTER

THE NEXT SESSION COMMENCES ON TUESDAY, 11th OCTOBER, 1960. C 796

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TENDERS

CARMARTHEN RURAL DISTRICT COUNCIL WATERWORKS

CONSTRUCTION OF PUMPING STATIONS SERVICE RESERVOIR AND PIPELAYING CONTRACT A
AT LLANGYNIN, CYNWYL ELFED AND RHYDERGAEAU, CARMARTHEN

The Council invite Fixed Price Tenders from Experienced Contractors for the construction of three small pumping stations; a small concrete service reservoir of 20,000 gallons capacity; and supplying and laying about 8 miles of 3 in. and 4 in. spun iron pipes and about 1½ miles of 2 in. asbestos cement pipes, all with flexible joints.

The General Conditions of Contract, Specification, Bill of Quantities, and Form of Tender, for this Contract, prepared by the Engineers, Herbert Lapworth Partners, 25 Victoria Street, Westminster, S.W.1, may be obtained from the UNDERSIGNED on or after Monday, 26th August, 1960, on receipt of a cheque for £5 0s. 0d. made payable to the Carmarthen Rural District Council, which sum will be returned on receipt of a bona fide tender.

Tenders, together with all documents received are to be enclosed in a sealed cover endorsed "Waterworks—Tender for Contract A—Pumping Stations, Service Reservoir and Pipelaying" and addressed to the UNDERSIGNED and delivered not later than 10 a.m. on Monday, 26th September, 1960.

Only tenders from firms experienced in this type of work will be considered.

The Council do not bind themselves to accept the lowest or any tender.

T. E. WILLIAMS,
Clerk.
3 SPILMAN STREET,
CARMARTHEN. C 787

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SLICE VIII

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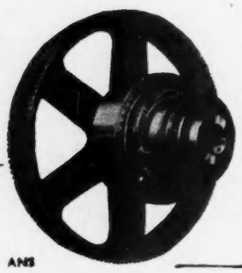

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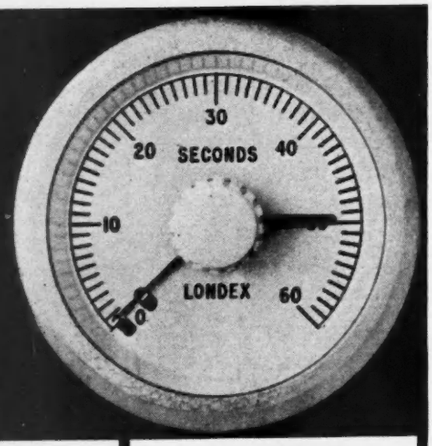

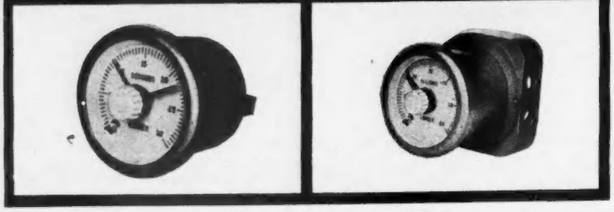

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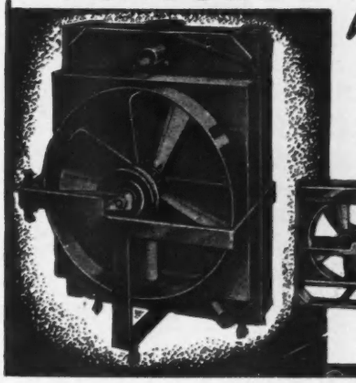

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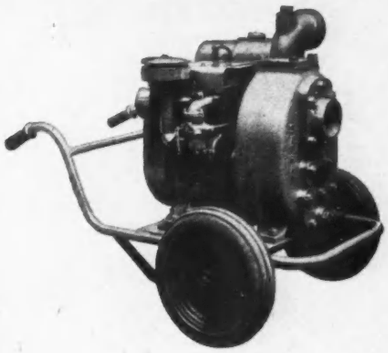

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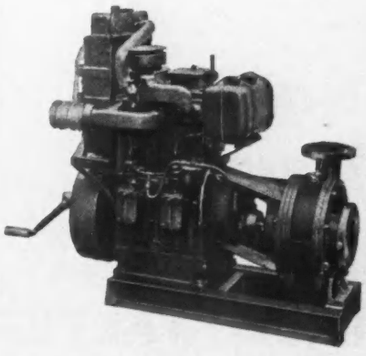

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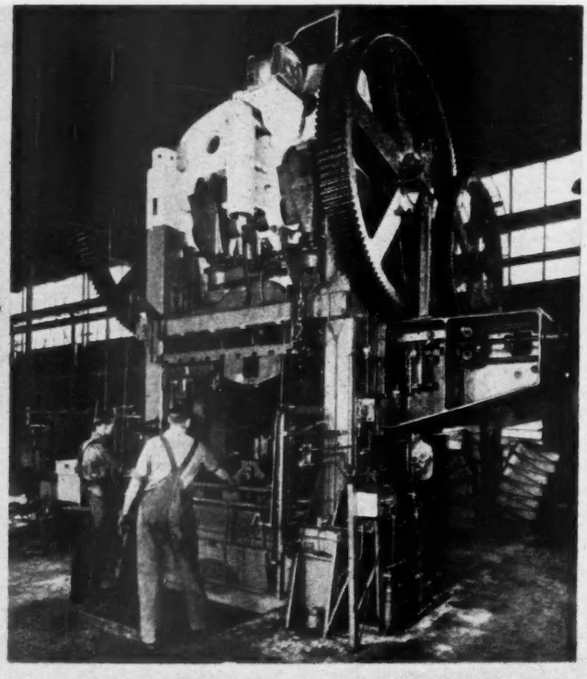

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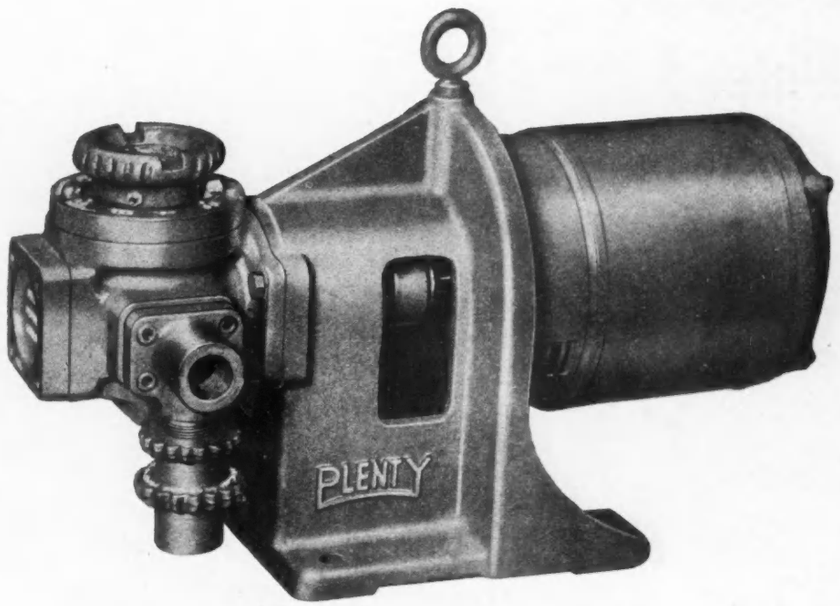

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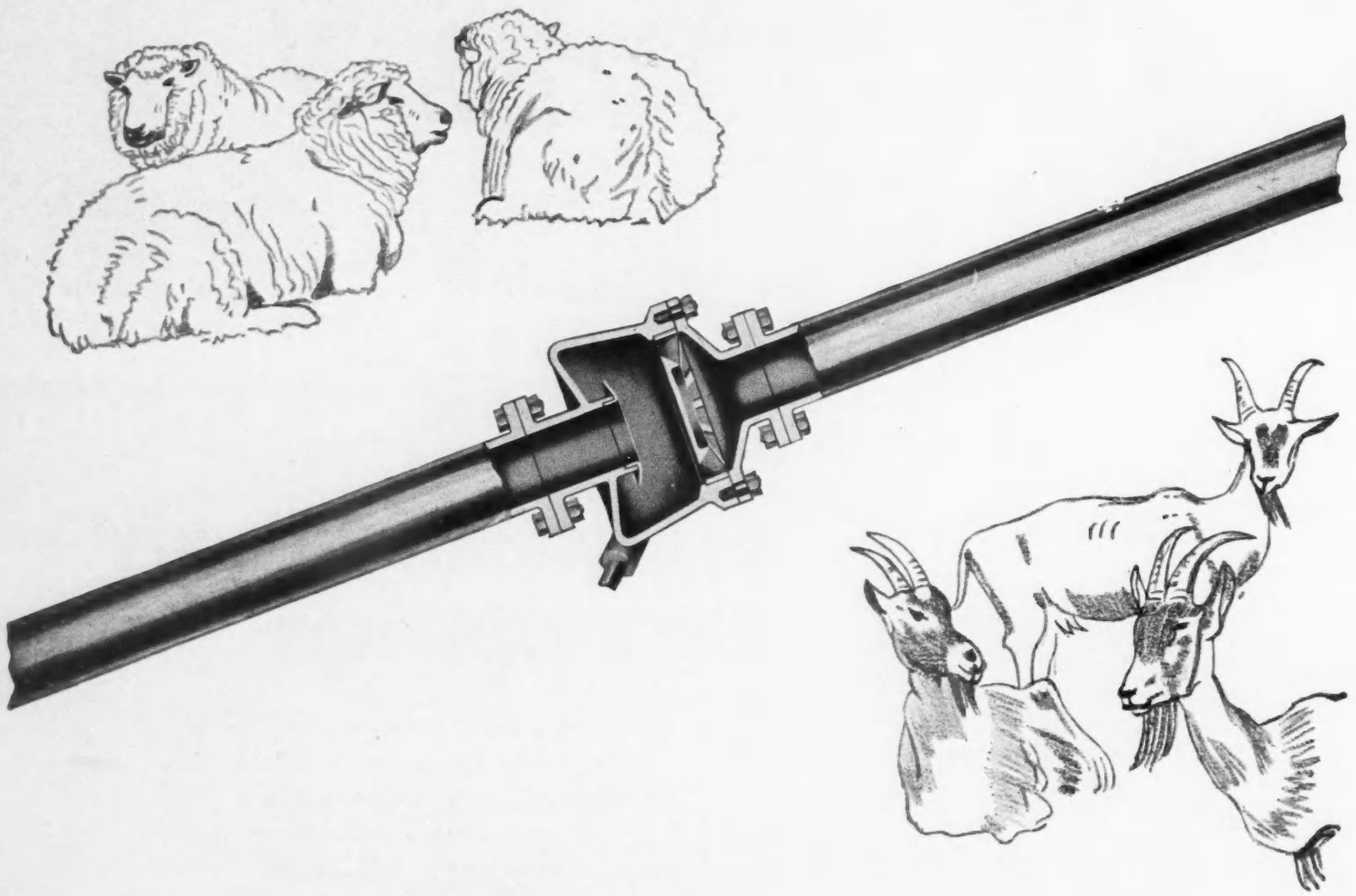

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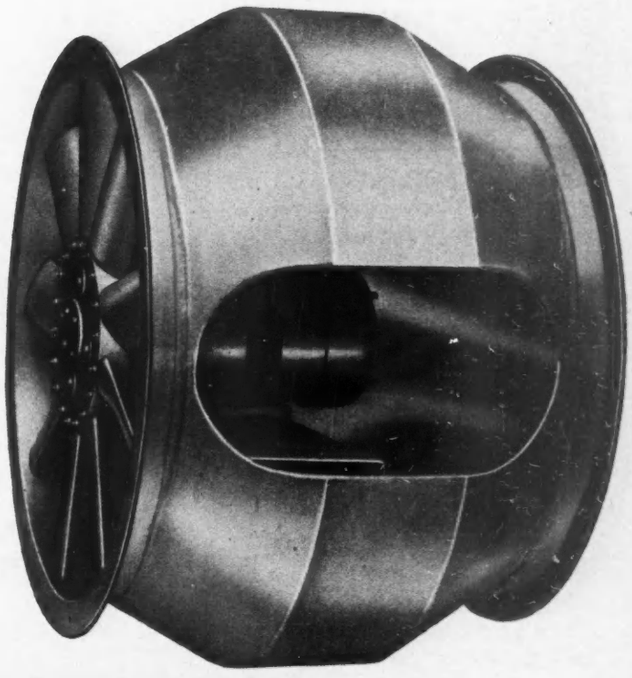

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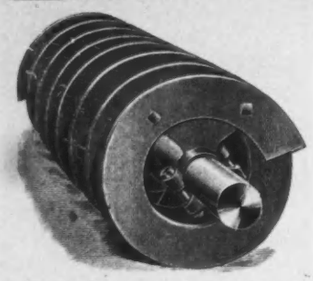

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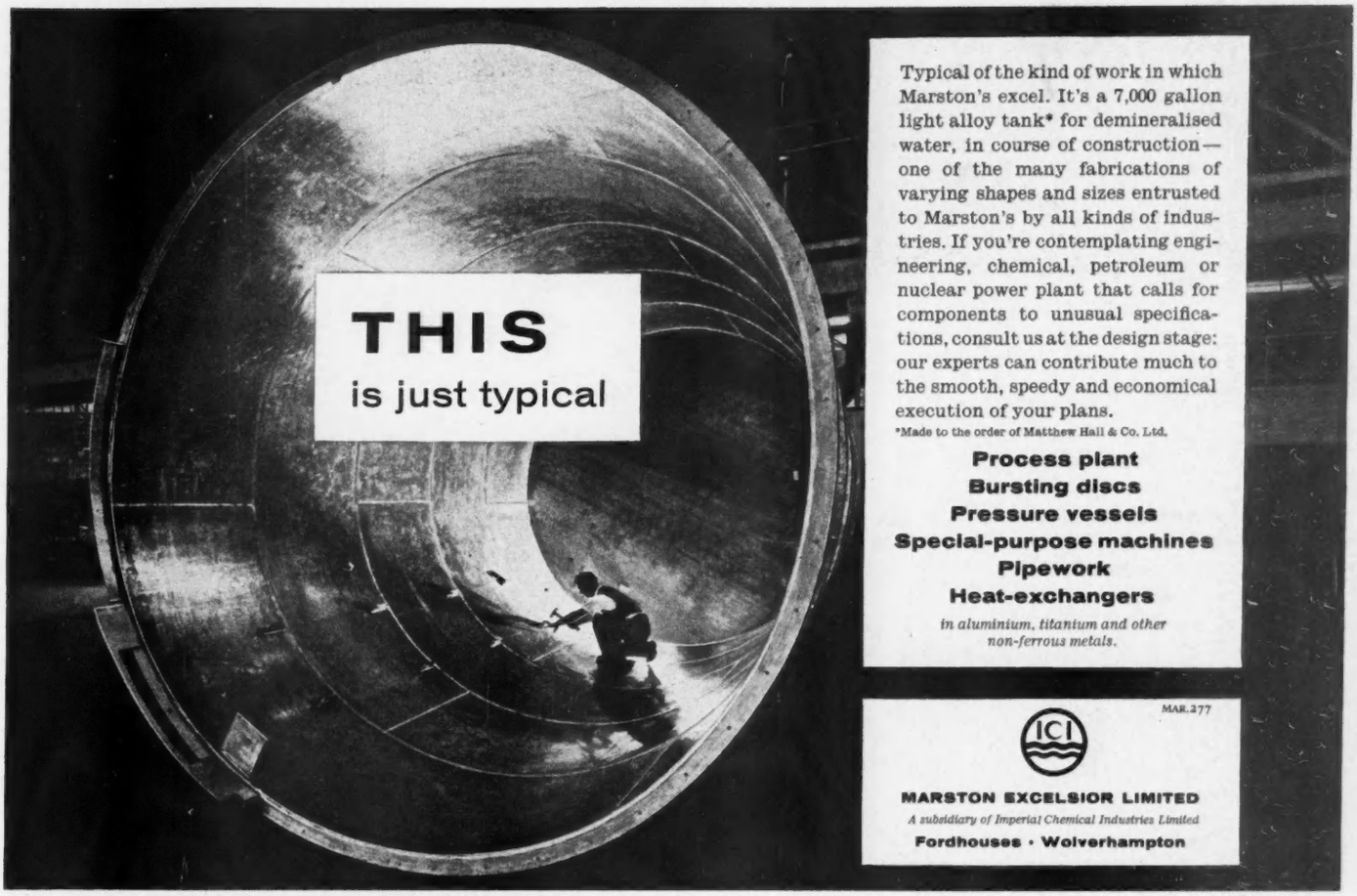

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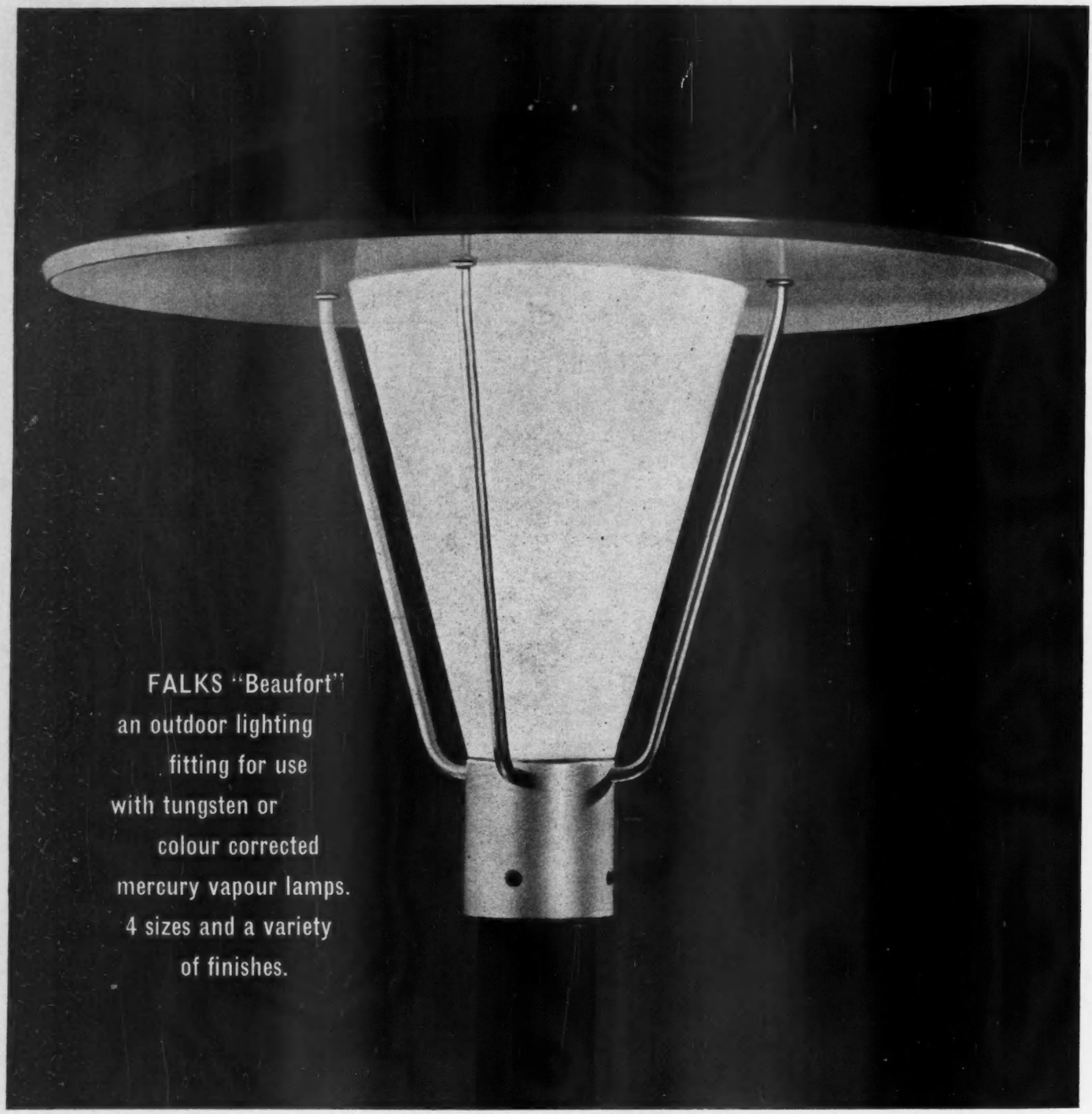

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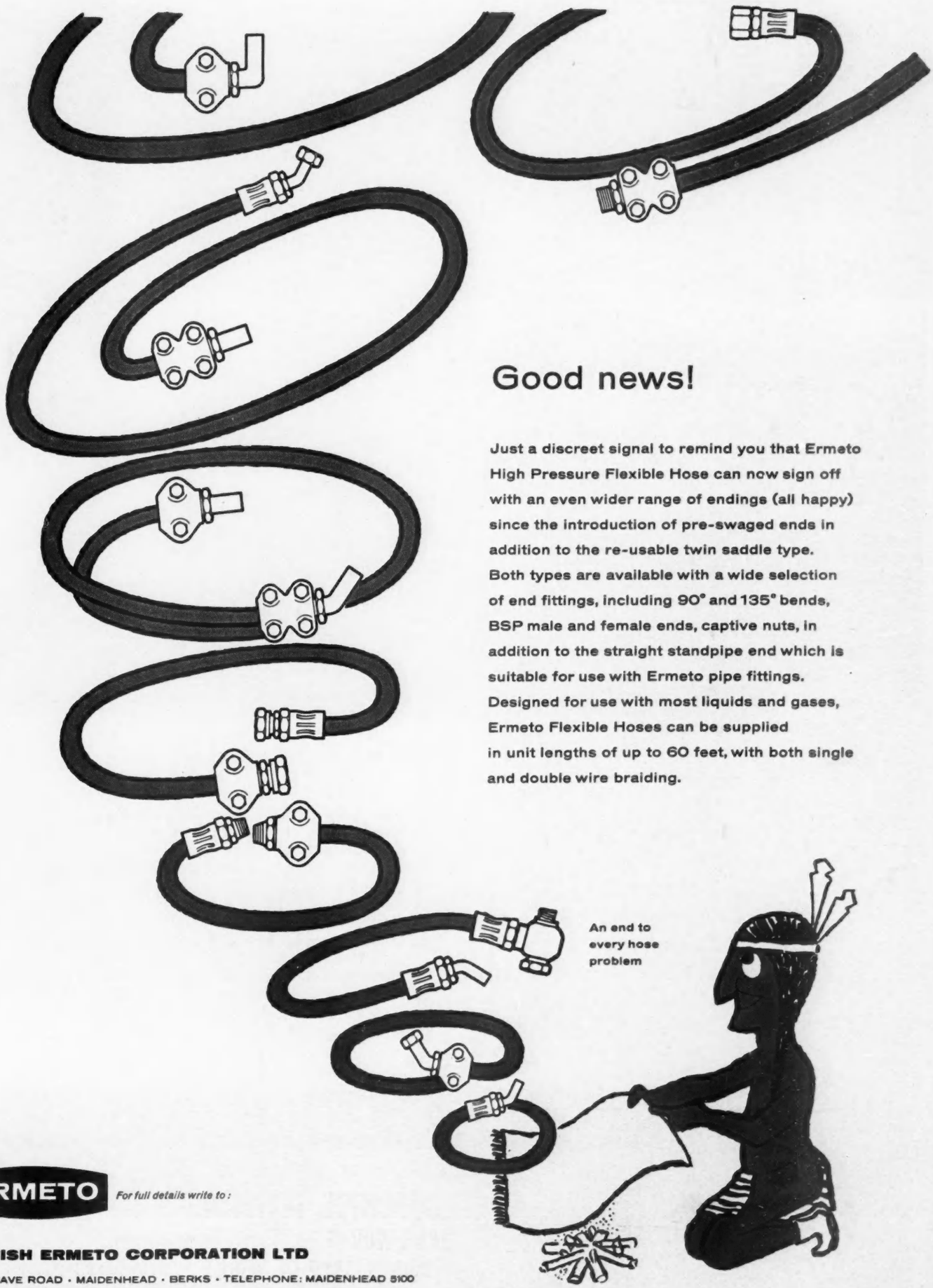

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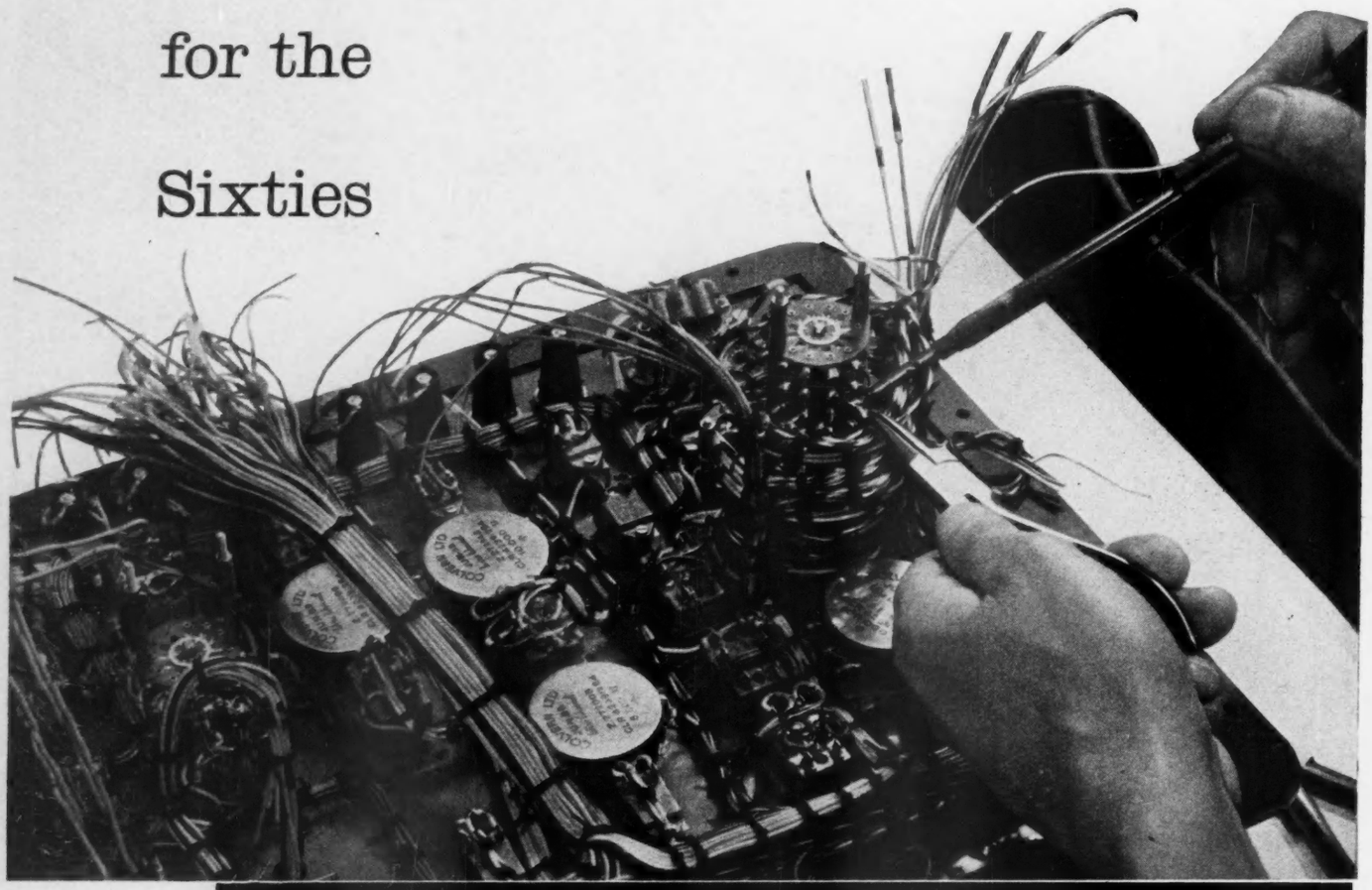

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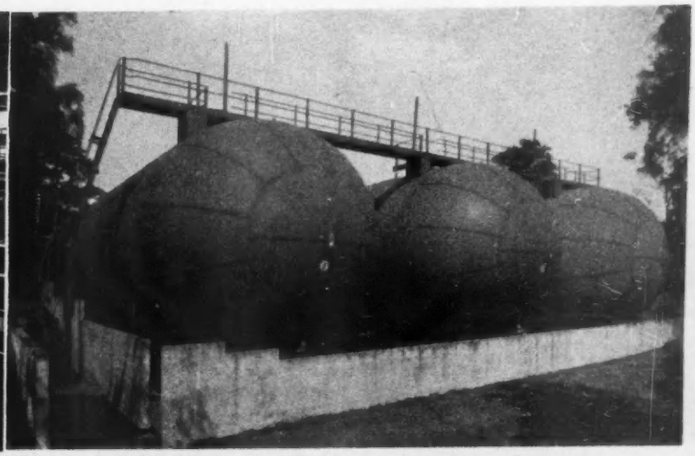

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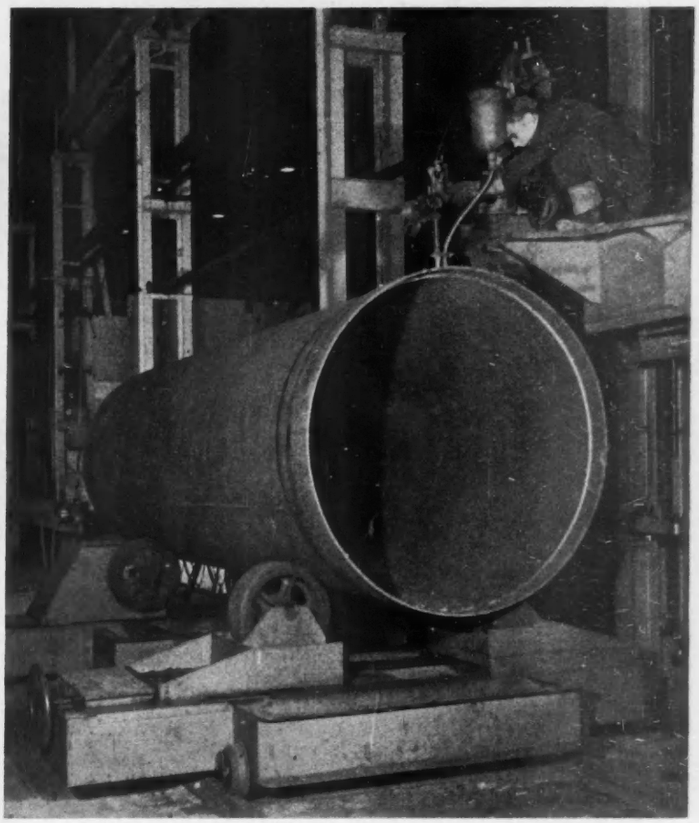
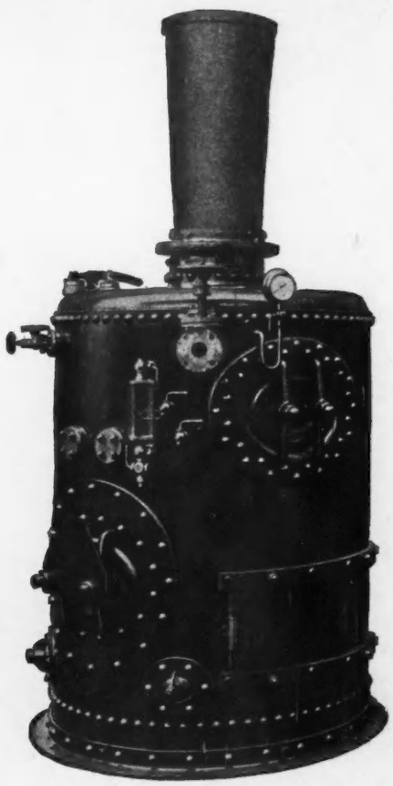
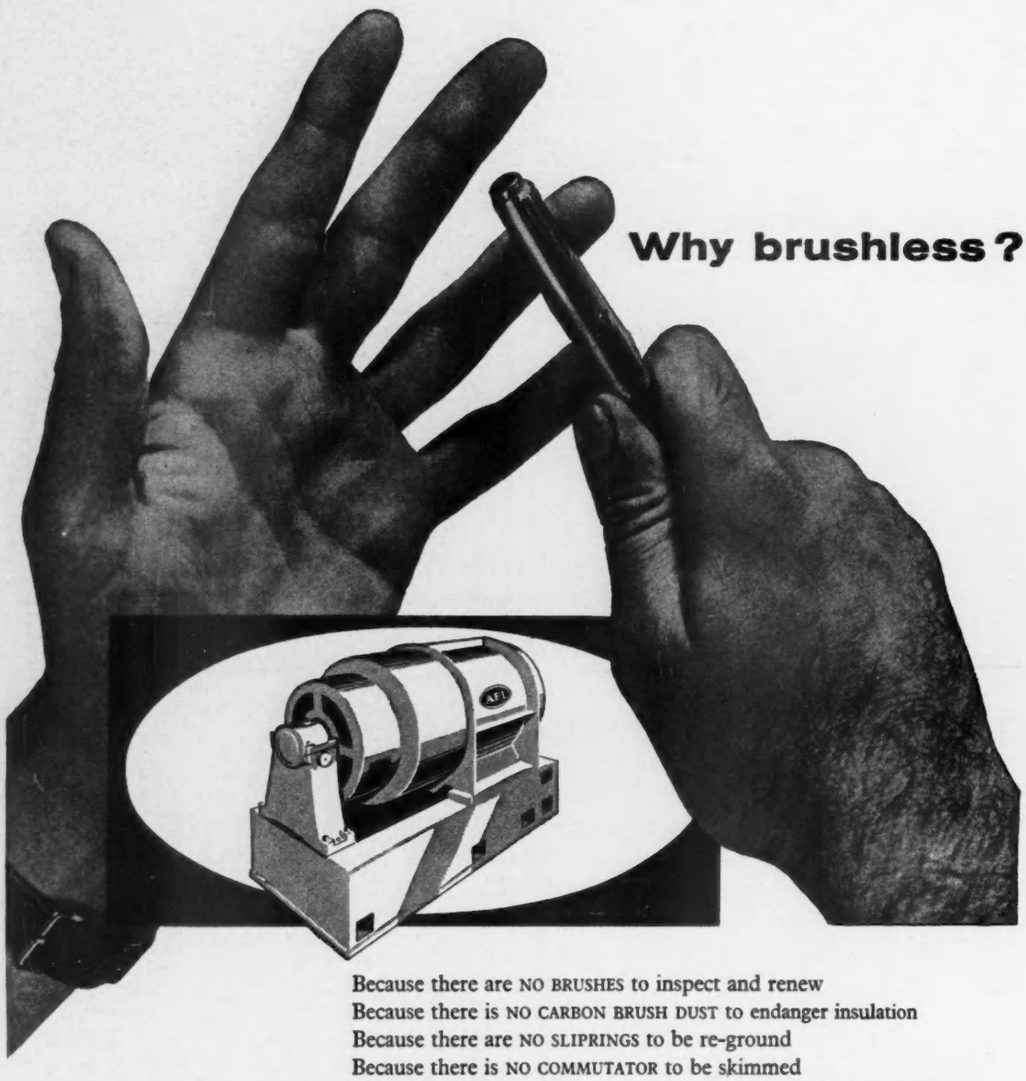


(*Top*) Precision welded steel pipes.

(*Below*) Concrete lined and sheathed pipes.



Hopwood vertical boiler.



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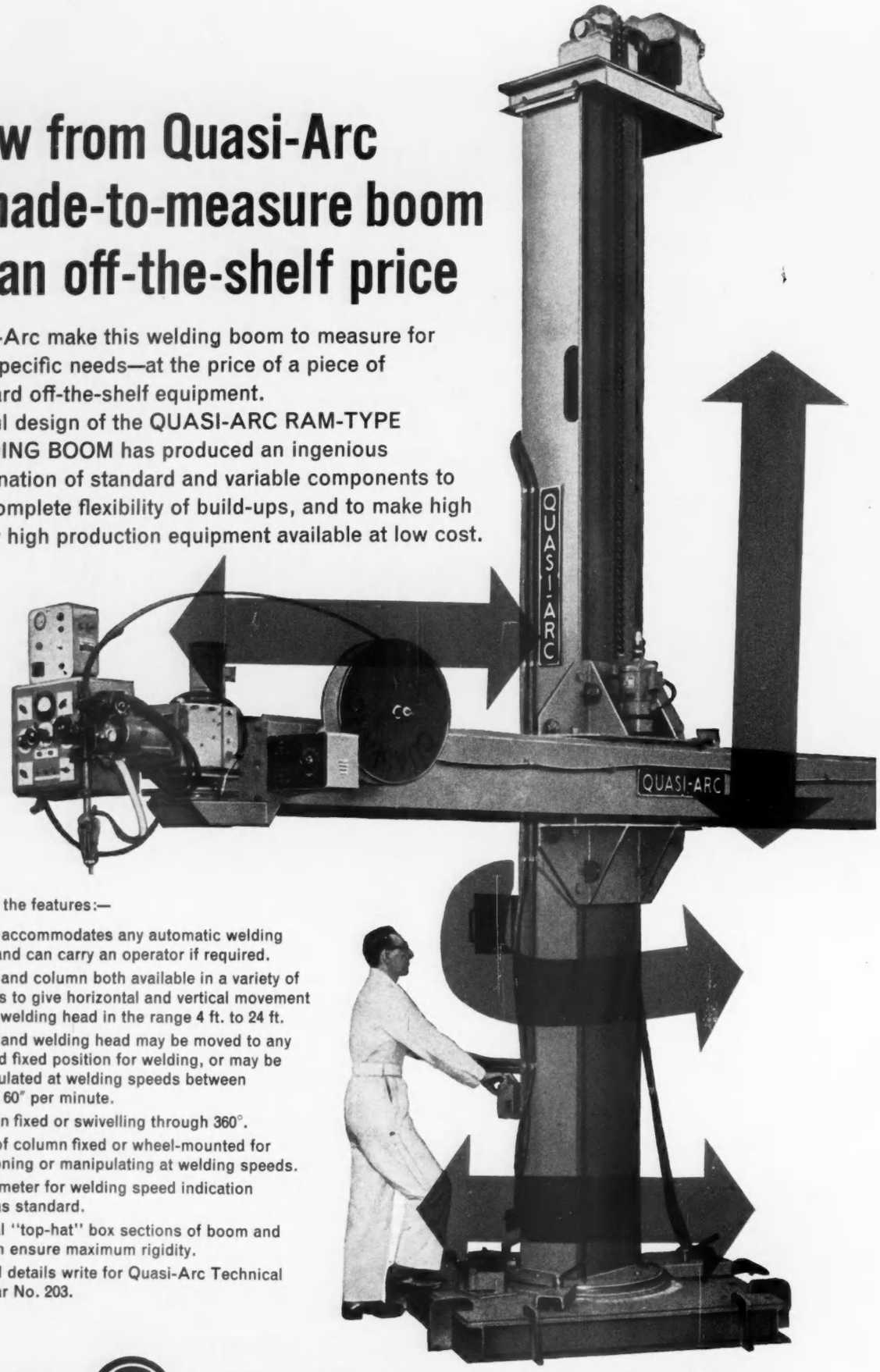
Quasi-Arc make this welding boom to measure for your specific needs—at the price of a piece of standard off-the-shelf equipment.
Careful design of the QUASI-ARC RAM-TYPE WELDING BOOM has produced an ingenious combination of standard and variable components to give complete flexibility of build-ups, and to make high quality high production equipment available at low cost.



Check the features:—

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- Boom and column both available in a variety of lengths to give horizontal and vertical movement of the welding head in the range 4 ft. to 24 ft.
- Boom and welding head may be moved to any desired fixed position for welding, or may be manipulated at welding speeds between 6″ and 60″ per minute.
- Column fixed or swivelling through 360°.
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- Tachometer for welding speed indication fitted as standard.
- Special "top-hat" box sections of boom and column ensure maximum rigidity.
- For full details write for Quasi-Arc Technical Circular No. 203.

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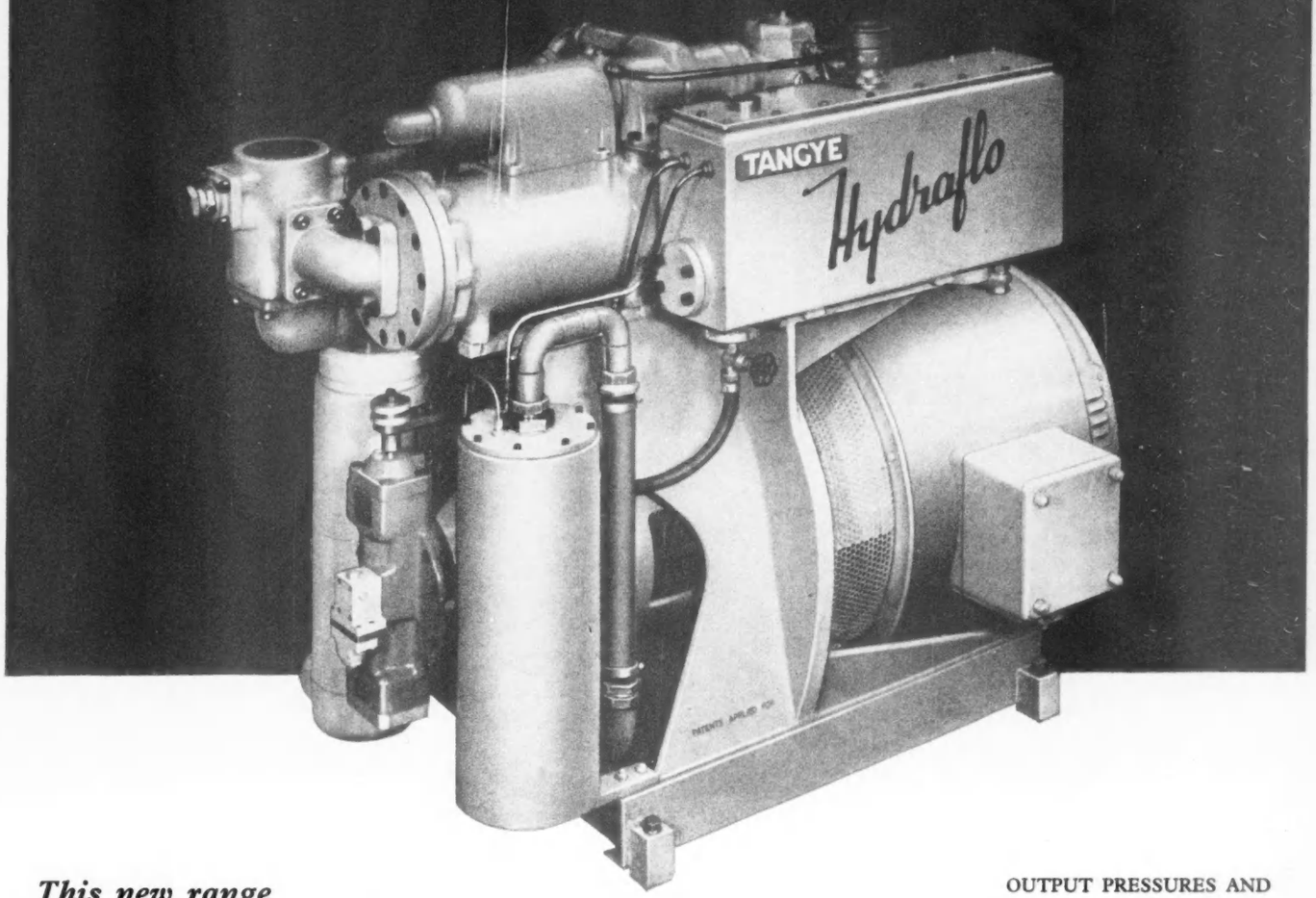
AN ENTIRELY NEW APPROACH TO HIGH-PRESSURE RECIPROCATING PUMP DESIGN



This new range

THE TYPE 'H' 'HYDRAFLO'

employing hydrostatic transmission, is a direct acting reciprocating pump, providing straight-line continuous output from a single cylinder, double-acting movement, but also with an infinitely variable speed providing an infinitely variable output from zero to the pump's maximum **and this can be manually or automatically controlled.** The standard automatic control is 'Constant Pressure Control' which automatically varies the speed of the pump to balance the circuit demands, maintaining a constant delivery pressure.

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OUTPUT PRESSURES AND OUTPUT QUANTITIES

The duty range of the pumps covers output pressures up to 9,000 lbs. p.s.i. (when the output quantity would be about 10 gals. per min.) and output quantities up to 75 gals. per min., (when the output pressures obtainable would be in the region of 1,200 lbs. p.s.i.). Powers available are up to 90 H.P. input.

A COMPREHENSIVE DESCRIPTION OF THIS NEW RANGE IS AVAILABLE

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These are the manipulative skills without which no amount of steel science would avail much—the skills which are "in-grained" into Firth Brown Special Alloy Steels.

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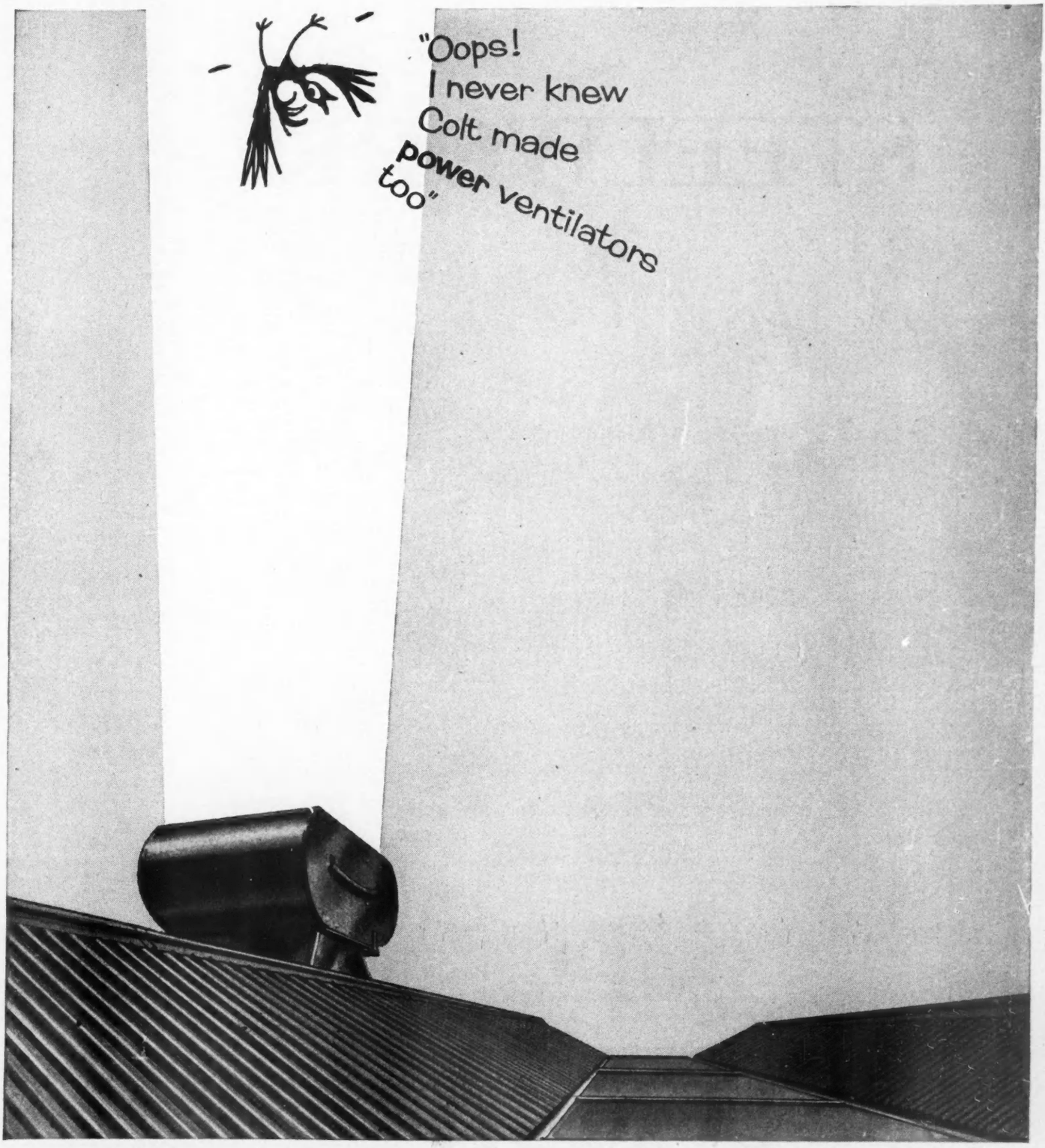

They do! Colt have a ventilator, natural or powered, to meet every kind of problem—including a range of high powered ventilators such as the Upward Discharge unit shown here. Let the Colt Ventilation Service advise you. Powered or natural, or a combination of both—the Colt engineer will tell you which system is best and most economical for you. Send for a manual to Dept. 37

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C2

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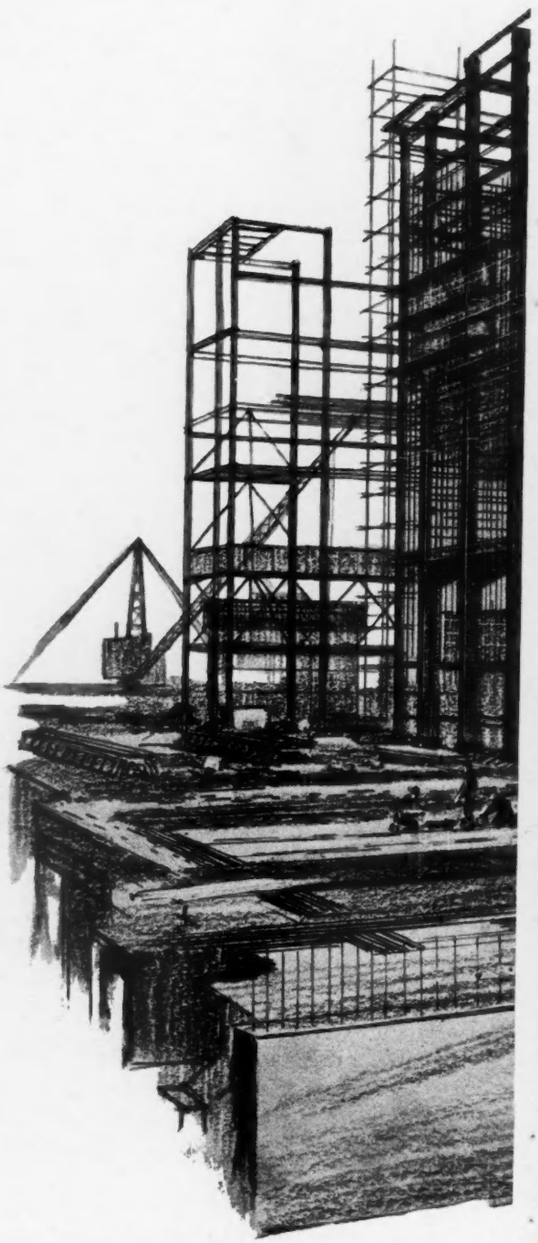
for Power

The contract for the Willington 'A' generating station, comprising the supply, delivery and erection of over 5,000 tons of steelwork, provides another vital section in the programme being undertaken by the Central Electricity Generating Board. Optimum co-ordination and ample resources are necessary for the successful completion of such extensive projects.



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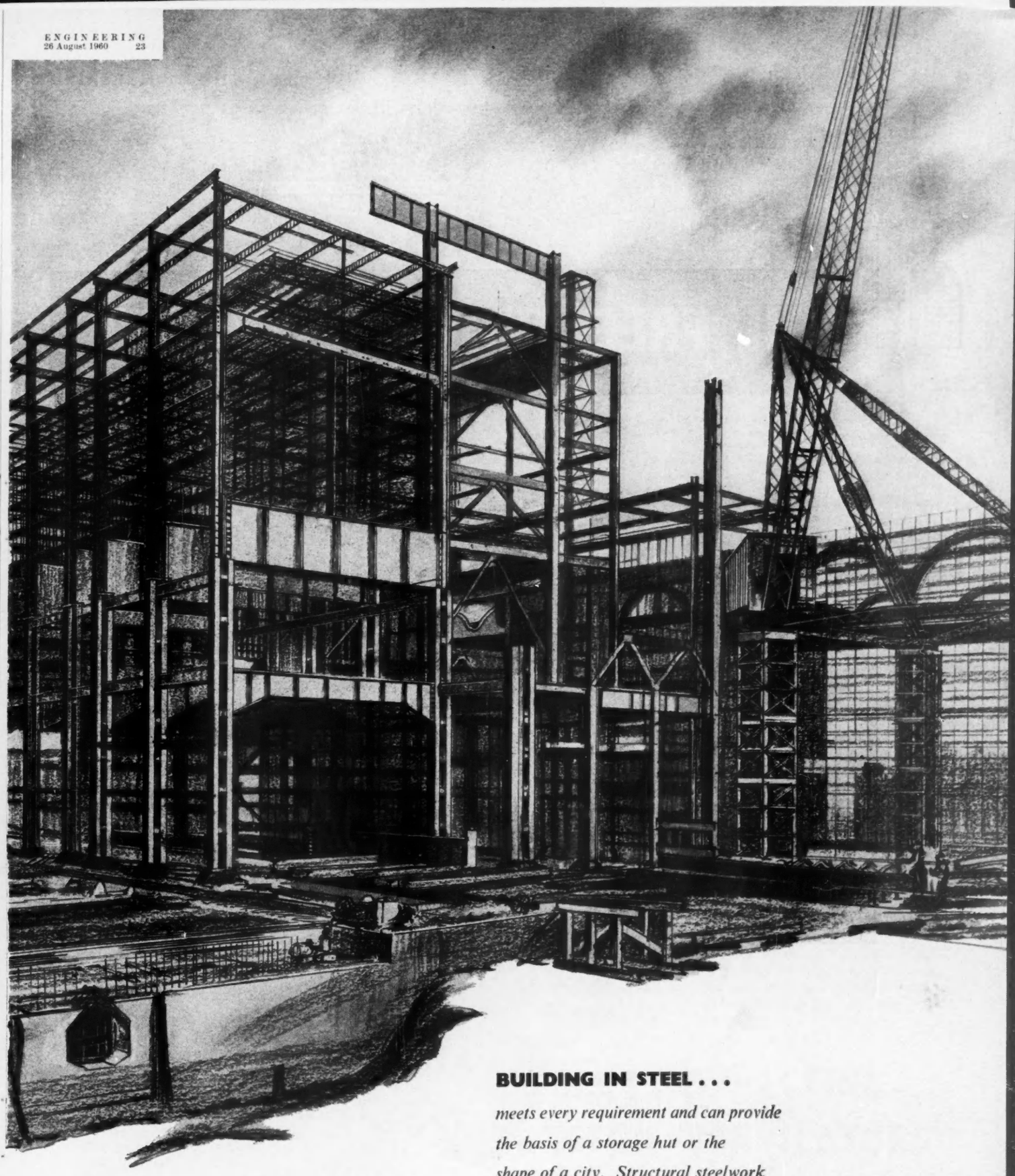

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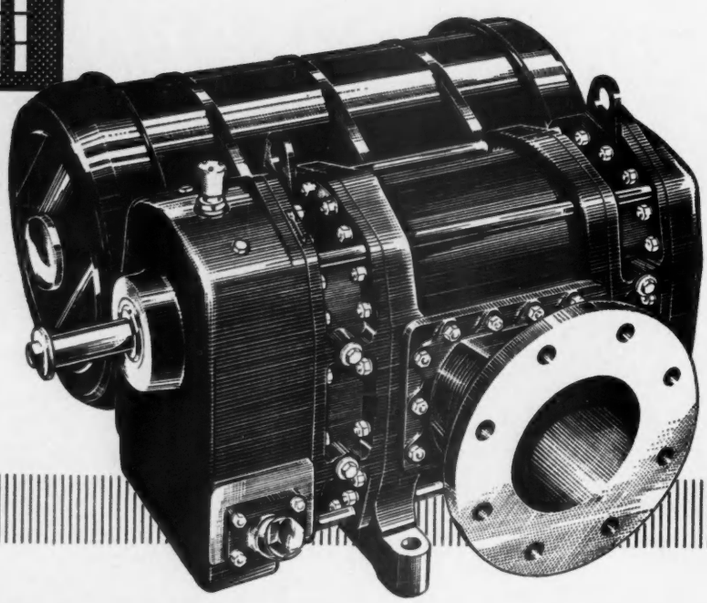

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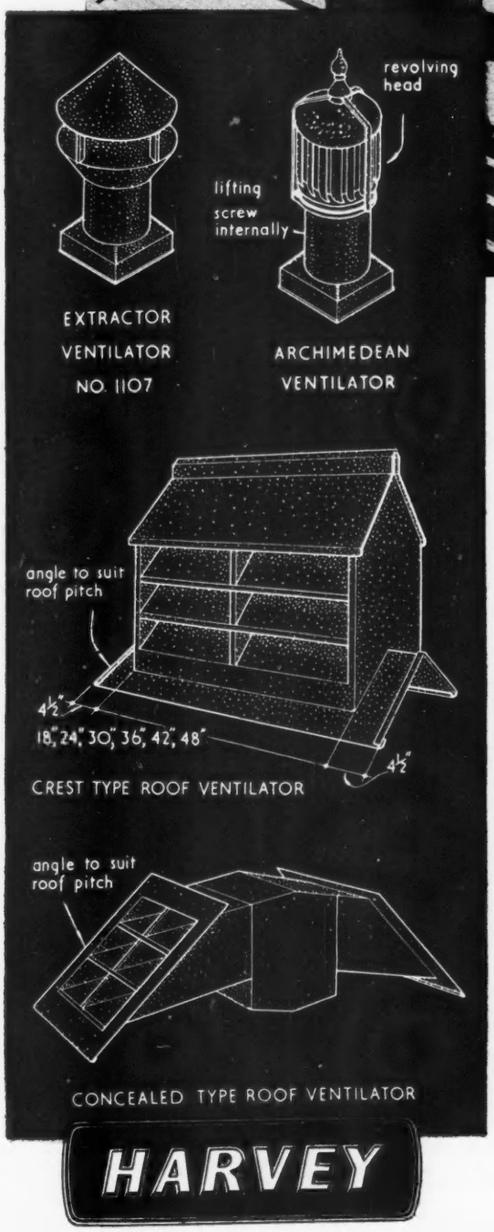

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'Harco' Self-acting Extractor Ventilators use the action of wind across specially designed louvres to induce a powerful upward suction movement of air, and at the same time prevent down draught. Allied to a correctly calculated number of air inlets, this type of "natural" ventilation will effect the changes of air required by normal conditions without recourse to mechanical forms of extraction. All ventilators are craftsman-made in zinc or mild steel, and can be supplied with or without roof seating as required.
Details are in our Catalogue No. 924; and we will readily advise on and suggest a suitable form of ventilation for any type of structure.

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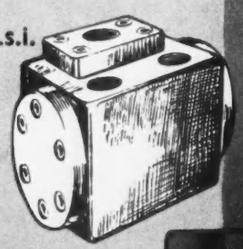

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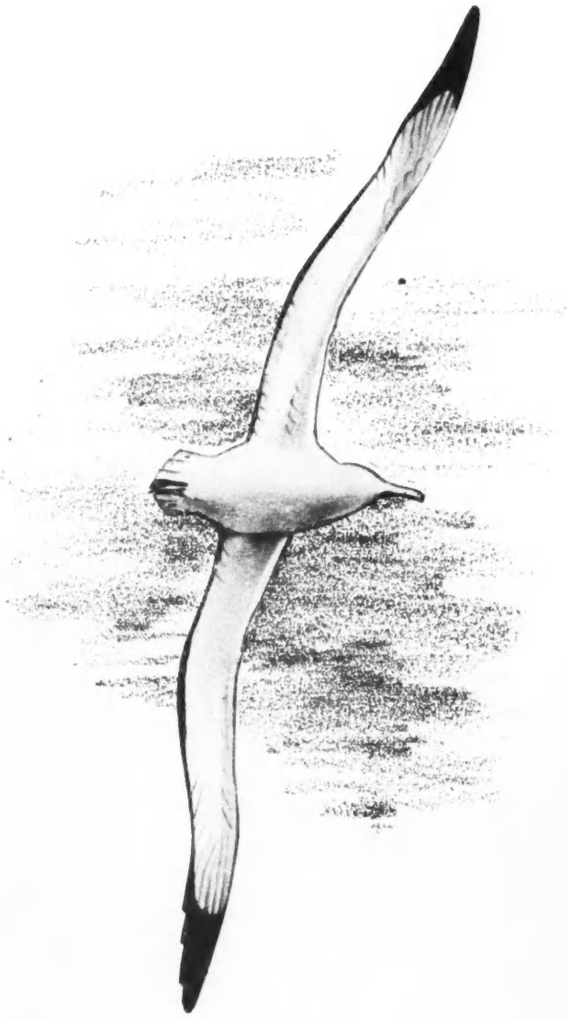

I travel alone

On and on . . . days and weeks at a time . . . through fair weather and foul . . . alone, but always safe and sure.

And, like the albatross, a Renold conveyor chain is very often alone too . . . because the maintenance engineer knows he needn't be in close attention once it has been installed. A Renold conveyor chain will go on and on for very long periods, free from breakdown and giving maximum service for minimum attention.

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WITH ATTACHMENTS FOR ALL DUTIES

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The Wrestlers, Florence Ufiz

One way of keeping a good man tied down is to have him wrestle with a welter of competing firms all peddling different pieces of finishing equipment. He gets involved in a mass of unnecessary detail which tends to obscure the overall picture of a complete finishing system. That is why so many leading manufacturers have released their staff from the pressure of product finishing detail. Instead they delegate the whole responsibility to a single specialist organisation — Lysaght-DeVilbiss. With over fifty years' specialised experience of product finishing in its broadest aspects, this organisation has the know-how and skill to provide the complete system best suited to your product. Lysaght-DeVilbiss design, manufacture and install complete product finishing systems from metal pre-treatment to final stoving. For a sound, unbiased opinion, get on to Lysaght-DeVilbiss. No obligation, of course.

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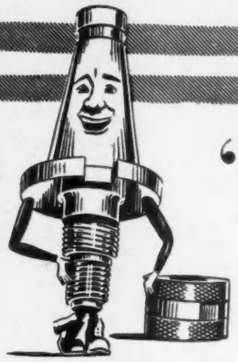
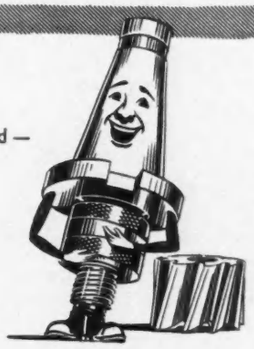
Screw-locked milling... AT IT'S SIMPLEST & MOST EFFICIENT



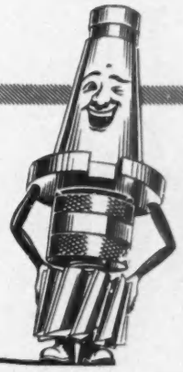
"They've done it again! You can rely on Dormer to turn out the tools for peak performances with the greatest accuracy and the least trouble. Look how easy this is....."

DORMER HELI-MATIC ARBORS AND SCREWED BORE CUTTERS

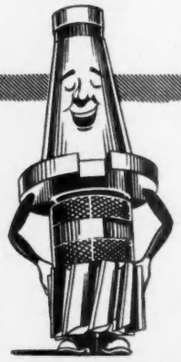
This high efficiency combination simplifies screw-locked milling and achieves the greatest productivity.
Ease of assembly, precision in performance, and duration of working life, are the outstanding features of the Heli-Matic equipment.



FIRST STAGE
Screw on the nut by hand — as far as it will go.



SECOND STAGE
Screw on the cutter to meet the nut — then release by a part reverse turn.



THIRD STAGE
Screw back the nut firmly against the cutter by hand — immediately cutting starts the cutter will lock solidly against the nut, making a rigid tool assembly.

TO RELEASE
Apply the spanner to the nut and a few sharp hammer blows will release the nut from the cutter, which can then be screwed off by hand.

You can't go wrong — send for the Heli-Matic brochure giving the full range of Arbors and Cutters.

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THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED
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DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS

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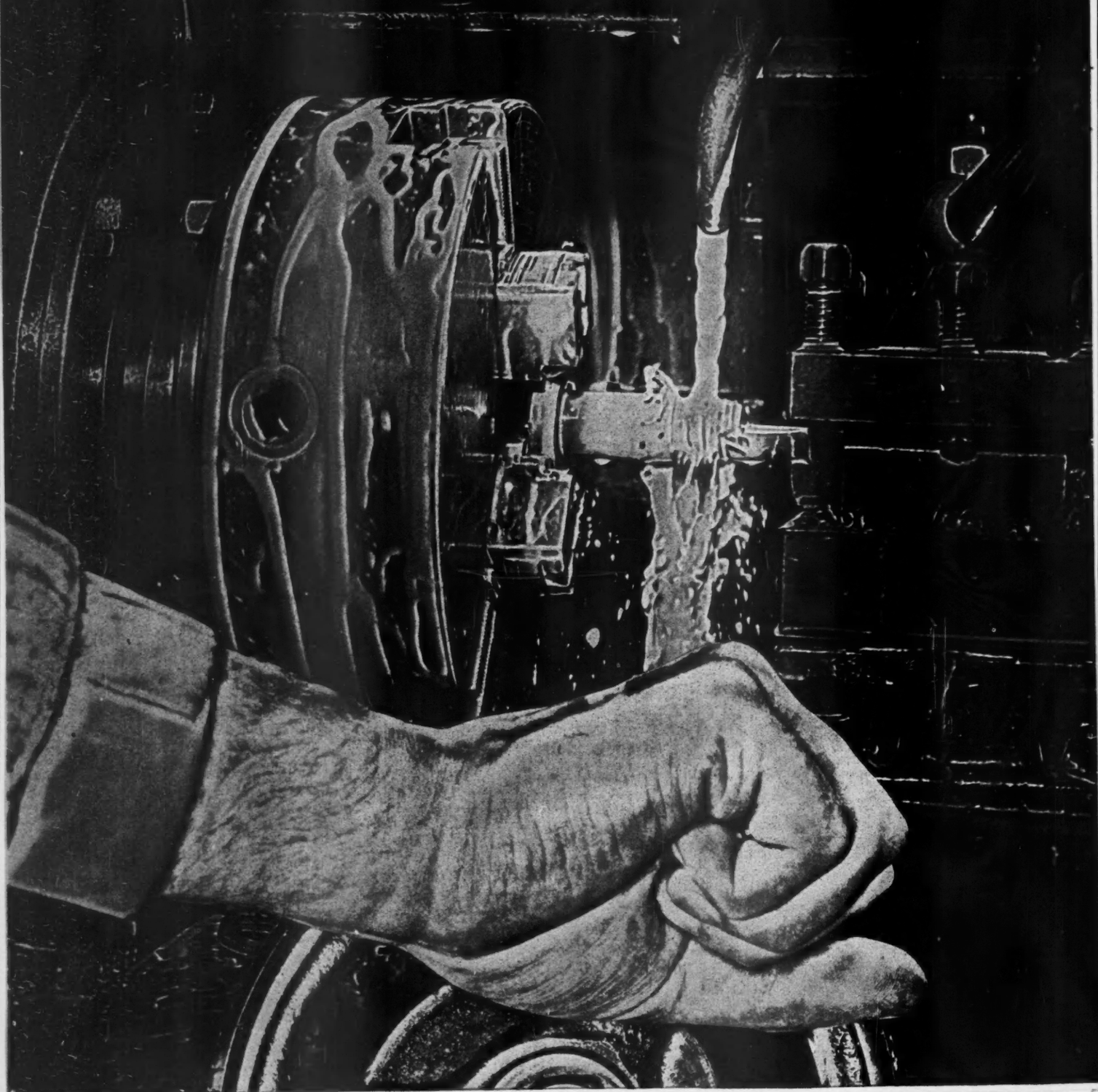


With new Shell Dromus Oils

Most modern soluble cutting oils contain phenolic compounds used as coupling agents between the oil and the emulsifier, for better blending and easier mixing. These phenolic compounds can cause skin irritation, especially where modern high-speed machines are used and the emulsion can concentrate, through the evaporation of water, above the safety level.

Shell research chemists have been working on this problem, which has been causing some concern to Management. After considerable research, Shell Dromus Oils have been reformulated and these new cutting oils now produce bland emulsions, which considerably reduce the risk of skin trouble to operators.

The real difficulty was to find a new coupling agent to replace the phenolic compounds, and Shell finally used what their chemists know as a higher fatty alcohol complex. This solved one problem, but presented another. The new coupling agent was volatile at the high temperatures normally used in blending processes. Further research found a solution to this problem by designing and installing new plant. The new Dromus Oils are every bit as efficient as before and cost no more. They put Management in the welcome position of being able to minimise working hazards at no extra cost. And machine men need no longer be so worried about skin troubles.

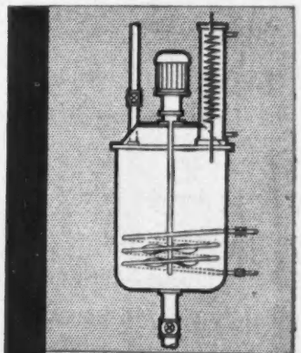
The moral of the story is that Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organisation have any major lubricating problems, it pays to get in touch with your local supplier of Shell Industrial Lubricants.

The Research Story

Shell chemists in the U.K., in Holland and in the U.S.A., prepared and examined hundreds of experimental soluble oils, and established that certain combinations of fatty alcohols could be used in place of phenolic compounds with no loss of efficiency. They set to work to discover the best combination and developed a higher fatty alcohol complex which fitted exactly. Then they realised that to blend this new coupling agent into soluble oils would require special plant and new blending techniques.

Exhaustive testing of blend stability, emulsion stability, anti-corrosion and machining properties led to selection of the most promising blends. A pilot plant was set up to produce batches of these for use in field trials.

This field testing and final development proceeded for two years whilst production plants were erected at points so chosen as to give the most economical and rapid delivery throughout the United Kingdom.



This is the blending kettle. The reflux condenser beside the stirrer motor prevents the loss of constituents volatile at the blending temperature.

NEW SHELL DROMUS SOLUBLE CUTTING OILS

another proof of Shell leadership in lubrication

FABRICATED CYLINDERS, CYLINDER LINERS, WINDING DRUMS AND CRANE BARRELS

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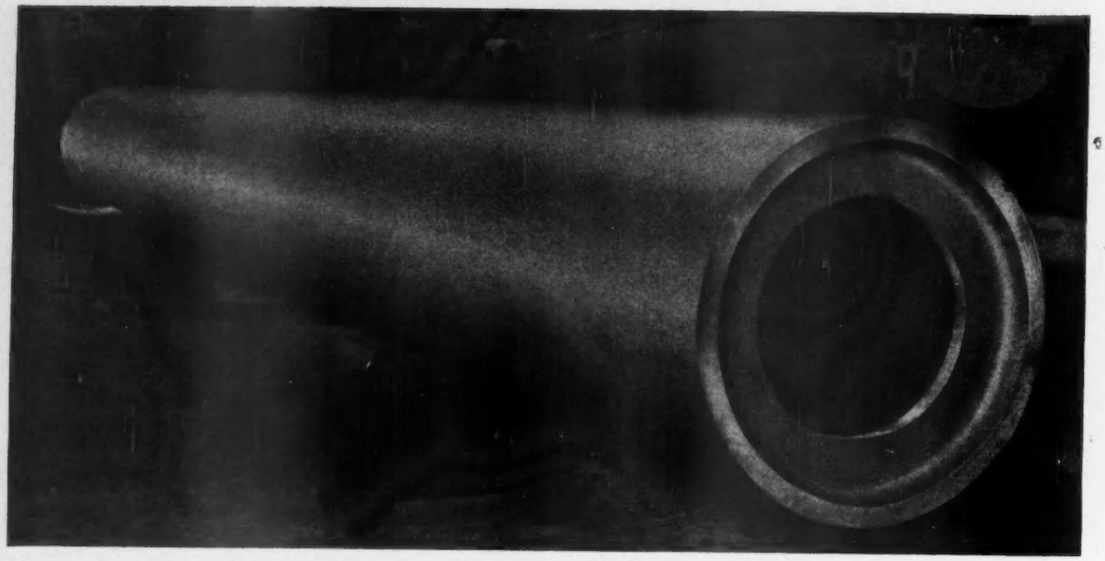

A WINDING DRUM 30FT. LONG × 2" THICK

Enquiries to

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HYDRAULIC PRESSES & MACHINES

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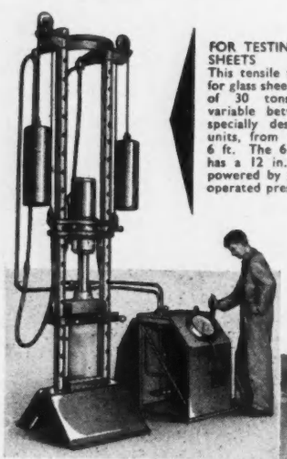
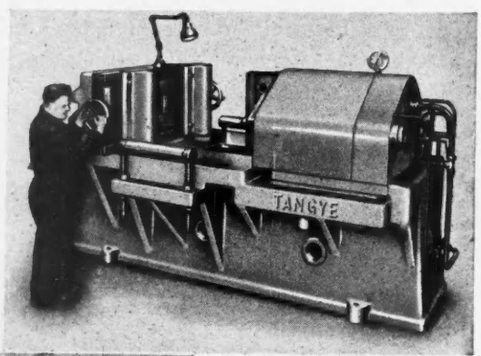
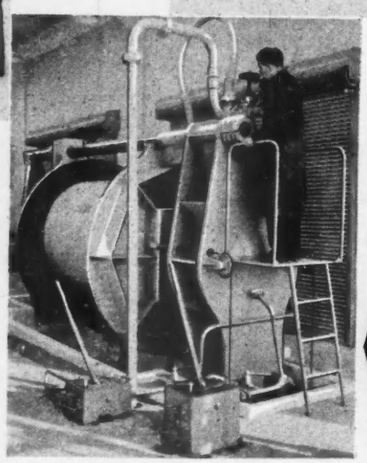
'Tangye' Hydraulic Power, in the experienced hands of the Hydraulic Division designers, is tailored to suit the exact operation it will be called upon to perform. It is therefore possible for us to gratify our customer's every wish and we are not tempted to persuade him to 'make do' with a standard design for we know we can offer something a little better.



FOR TESTING GLASS SHEETS
This tensile testing machine for glass sheets has a capacity of 30 tons. Daylight is variable between the two specially designed gripping units, from 1½ in. to over 6 ft. The 6 in. diam. ram has a 12 in. stroke and is powered by a Tangye hand-operated pressure pump.





FOR BENDING OR STRAIGHTENING AND CERTAIN CLASSES OF FORGING
The range of Horizontal Open Gap bending presses covers capacities up to 200 tons. Two adjustable anvils are on the resistance head and a similar tool is fixed to a moving platen. Daylight is 26in. After operating the ram is extracted, by hydraulic power. The anvils are easily removed for replacing by special tools when required. Equipment is provided to facilitate loading.

FOR PIPE TESTING
Large pipes to be pressure tested are clamped between two rubber-faced plates and are filled with water by either a gravitation feed or by a Tangye centrifugal pump. Pressure build-up is then achieved by a Tangye hydraulic hand pump. The above view is reproduced by kind permission of Norcon Ltd., in whose test house Tangye equipment is well in evidence.

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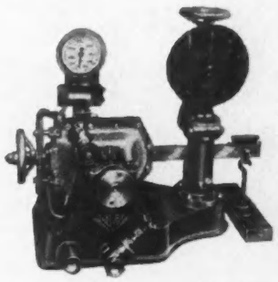

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FOR MOTOR CYCLE ENGINES, ETC.

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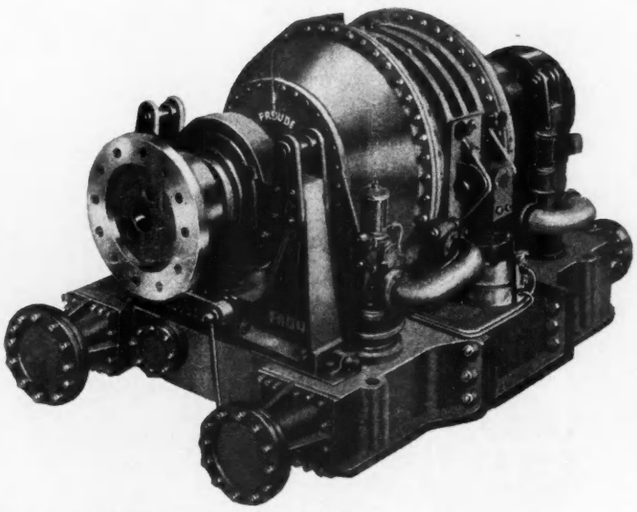

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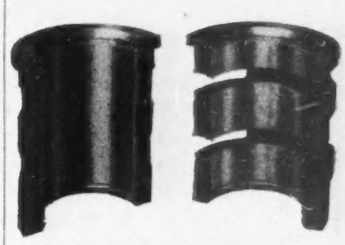

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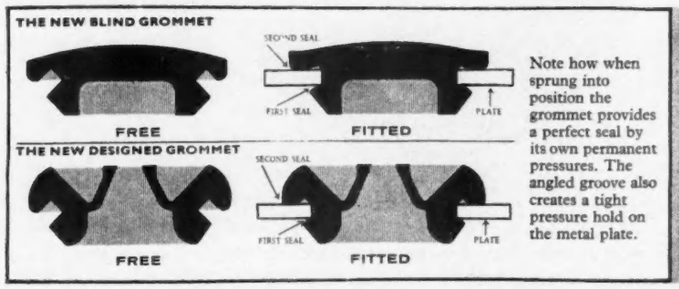
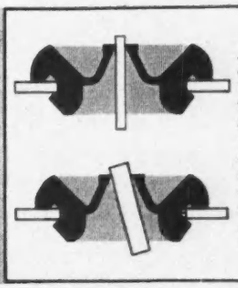
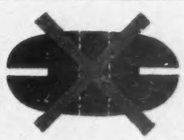


Note how when sprung into position the grommet provides a perfect seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size, are possible. This avoids necessity for special grommets with angled bores.



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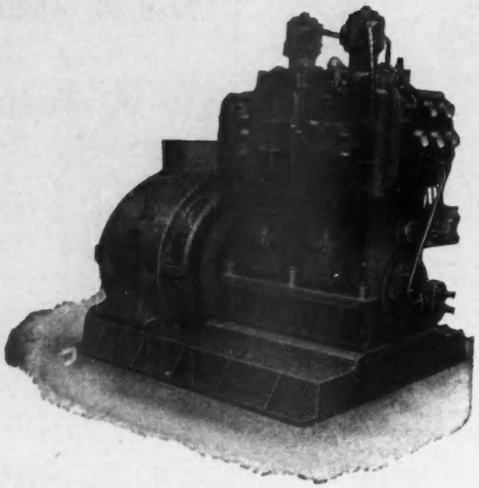

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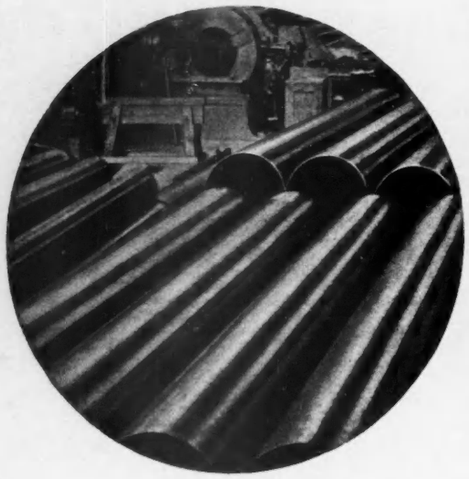

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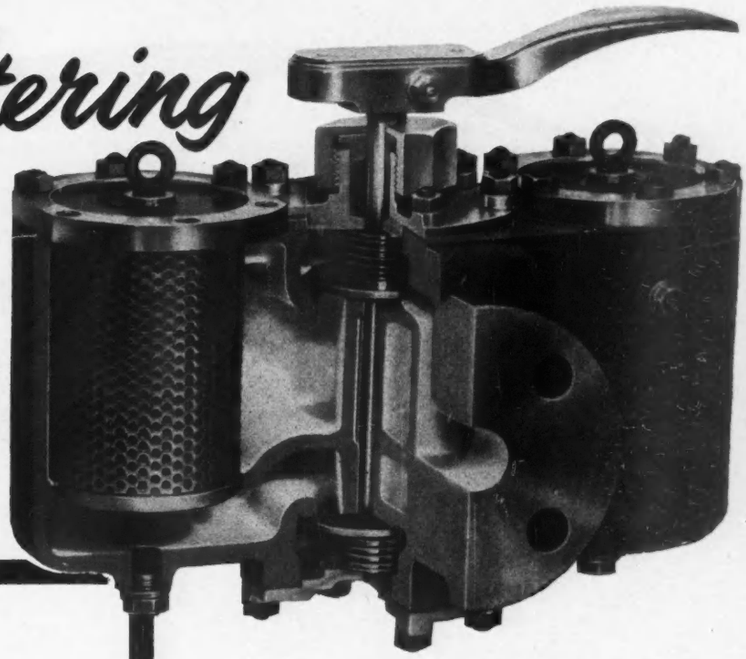

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The Rowen-Gloor cutting head will follow a sheet metal template automatically, controlled by a magnetic roller which follows the profile of the template. The complete drive unit including the magnetic roller is adjustable vertically so that it can readily follow the inner contours of the template. The direction of rotation of the magnetic roller is reversible, enabling the shape of the template to be traced in either direction.

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The Rowen-Gloor is a sturdy, simple to operate machine which will produce precision cuts at high speed in mild steel from ¼" to 4½" thick.

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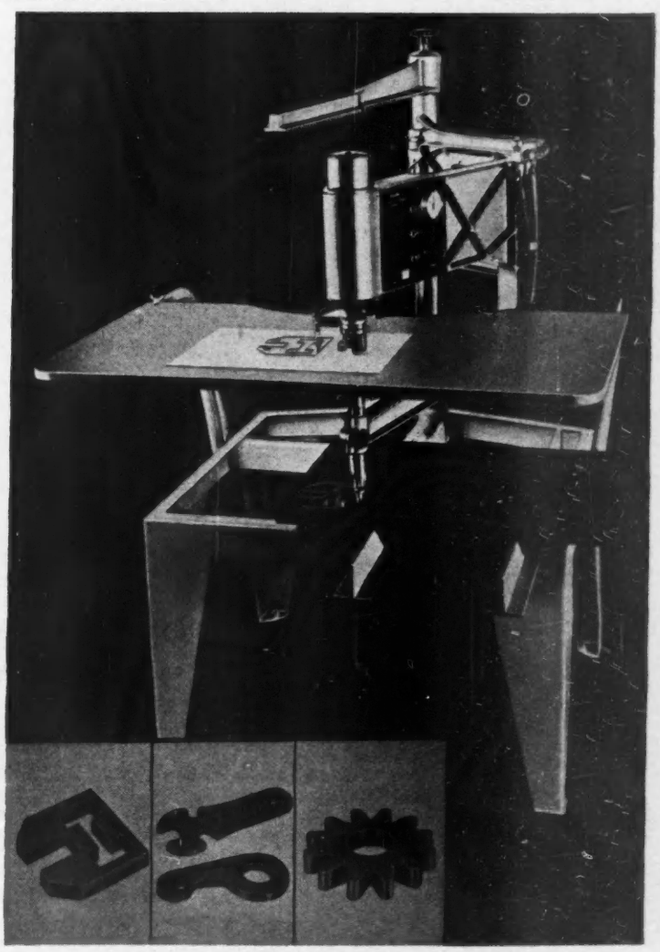

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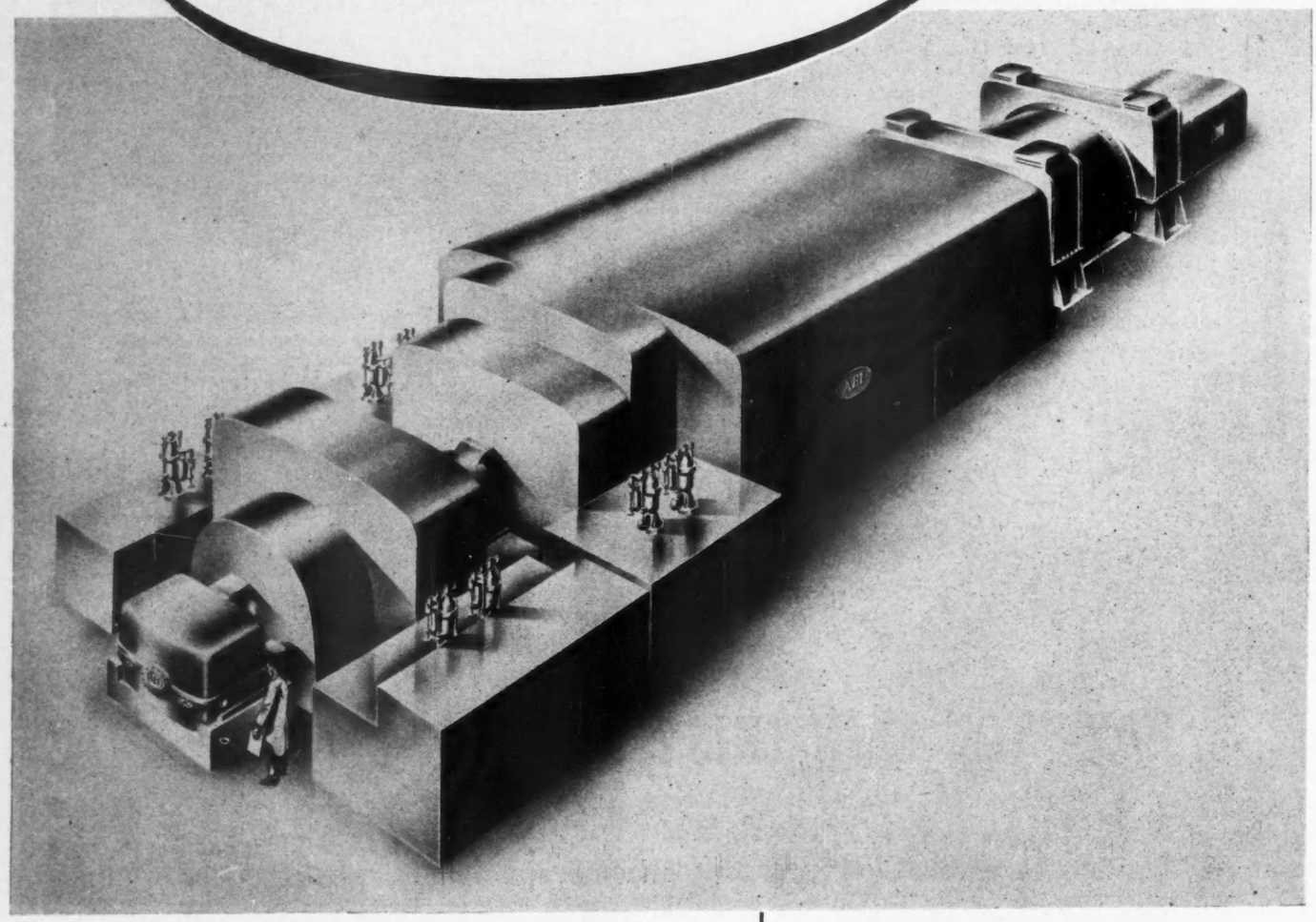

A new step in the development of power generating plant in Britain has been taken with the decision of the Central Electricity Generating Board to install large output turbine-generators operating at super-critical steam conditions. AEI, Britain's largest turbine-generator manufacturer, has received an order to build such a set with an output of 375 MW.

A 375 MW SUPER-CRITICAL TURBINE GENERATOR

Artist's impression of a 375 MW Super-critical Turbine-generator to be built for the C.E.G.B. Power Station at Drakelow. The turbine will have four cylinders arranged on a single axis operating at inlet steam conditions of 3,500 psig and 1,100°F. with reheat to 1050°F. The generator will be hydrogen-cooled with water-cooled stator windings, a system delevoped by AEI.

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ENGINEERING Impact

of Accumulating Appetites

War, it is often said, is too serious a matter to be left to soldiers. Food, likewise, is too grave a responsibility to be borne exclusively by farmers and fishermen. With world population growing at a rate of one per cent per annum, methods of food production, processing, preservation and distribution are likely to undergo a general tightening up and rationalisation. The pressure of accumulating appetites will be felt in many quarters.

In this context engineers, who have brought rationalisation to a fine art, will feel very much at home. Engineers have already played a modest part as subcontractors to the food industry; there may come a time when they assume a greater rôle in the exploitation of man's most fundamental resources. Food is big business; it is a field wide open to engineering enterprise.

Fields Wide Open to Engineering Enterprise

Engineers can bring new talents to serve the growing human appetite. An aircraft company has shown how aerodynamic principles can double the efficiency of harvesting. There is also ample scope in food production and distribution for that versatile industrial tool, operational research.

Apart from Mendel's discoveries, almost every major revolution in husbandry has been a fruit of engineering. The plough was a product of technical imagination. When Joseph Glidden invented barbed wire, which could be mass produced, he changed the whole character of American farming—from the open range of the cattleman with his vain plea "don't fence me in" to the divided prairie of the crop raiser.

Now it is possible to make a printed circuit of a field—allowing for trees, the line of a hedge, the nature of the soil—to guide a tractor's course, so that the farmer could gather his crops on a September night while fast asleep in bed. Milk is being distributed by pipeline in Italy. Fertilisers can be produced on an enormous scale to help increase the intensity of cultivation—notwithstanding those dissident elements who are convinced that "food is not what it was." But "engineered" food can taste even better—take frozen peas, for example, or Espresso coffee.

Producing food under controlled conditions holds great promise for the engineer: by underground or indoor farming under selective lighting we may grow corn in the desert or peaches in the arctic. The dairyman and brewer with their machinery for continuous pasteurisation and fermentation at closely regulated temperatures and pressures have shown the way to biochemical food production. With the advent of hydroponics, or the growing of food in tanks, man will be capable of survival on even the least hospitable planet, and the biochemical engineer will have come into his own.

Letting the Left Hand Know

In taking food as the theme of a complete issue, ENGINEERING is not simply seeking to capture the interest of food and agricultural engineers. That would be preaching to the converted. Rather, the object is to present their work to everybody else.

The scope offered to engineers of many specialities by the increasing demand for food has already been indicated. But there is another angle. Food technology has grown up in unusual circumstances, in many ways a branch of agriculture, isolated from the main stream of engineering. Because of their independent approach, food engineers may have a unique contribution to make to other lines of technical development.

Technical ideas, like prophets, often have a greater impact in some foreign field than in their native territory. Perhaps the instrument devised by the British Food Manufacturers' Research Association for testing the rheology or flow qualities of chocolate and other viscous foods may be useful in the handling of totally inedible materials. The highly sensitive control systems developed by pasteurising engineers may have applications in other regions of process engineering. The large-scale refrigeration techniques now being investigated may lead to new production methods requiring ultra-cold environments.

The Four Ounce Family Joint

Accelerated freeze-drying, described elsewhere in this issue, is not entirely new. What is new is its commercial application to the preservation of food.

Research initiated by the Ministry of Food at Aberdeen in 1948 with a view to rendering the process a commercial proposition has now been taken up by industry. The result has been the sale of a prototype commercial plant to the Irish Sugar Corporation.

The advantages of freeze-drying have long been known, but despite these the process has not hitherto been a practical commercial proposition for foodstuffs and its use has been limited to such commodities as blood plasma, pharmaceutical and similar products, where the cost of preparation has been small in relation to the value of the raw materials. Speed of processing has been increased threefold since research was first started, hence the term *accelerated* freeze-drying. But reduced drying speed alone cannot make a batch process really attractive. What is needed is a continuous process.

Vickers-Armstrongs (South Marston) Limited, who have taken over where the Government left off, realise this and are concentrating effort to solve the technical problems involved. So far the results promise that in a few years time we may be able to buy AFD processed food at shops now selling canned and deep-frozen foodstuffs.

Both these suffer limitations, but the heavy and bulky refrigerated containers associated with conveying and storing deep-freeze products render this process particularly vulnerable to competition from AFD. The weight of AFD processed food is only a fraction of that in its natural state, and the absence of elaborate container equipment will appeal to distributor, shopkeeper and housewife alike. Furthermore, reconstitution of most foods is very simple—just dip the dried product in water for a few minutes, then drain off the surplus. Its natural fresh qualities are then completely regained.

The canning and refrigeration industries do not yet appear to be seriously worried by this threat to their business. They would be well advised to start an AFD department in addition to their present organisation. This would at least provide another string to their bow, if not eventually surpass their existing activities in importance.

Of Bringing Fertility Back to the Desert

An immense undertaking in engineering, designed to bring fertility back to more than one and a half million acres of West Pakistan, has been authorised by the West Pakistan Water and Power Development Authority.

When the work is complete a thousand deep wells will have been made, the land should begin to return to its former fertility and the people of the region will be able to give up their search for other cultivatable ground.

An exceptionally high underground water level, in places within a foot of the surface, has meant that the very high summer temperatures have brought moisture up through the soil, evaporated it away and left a degree of salinity which has turned large tracts into desert.

Now by the use of deep wells, all of which are due for completion within two years, it is intended to lower the water table and allow natural drainage to leach the salt out of the ground. Pumps will take the water from the wells into canals so that it can be used elsewhere for irrigation.

Pakistan officials have calculated that the scheme will make possible an eventual rise in food production of 800,000 tons a year.

An English company, Frederick Parker Limited, of Leicester, have produced the gravel screening and storage plant to be used by the United States firm, Harold T. Smith International, who are handling the project. Each well in the £3 million scheme needs 54 tons of exactly graded gravel to form the pack preventing sand being carried into the wells by the water.

No Pause in Mechanising the Farms

The current passage of the farm workers' wage claim through the negotiating machinery has served to underline that the agricultural employee is, on average, about £3 a week worse off than his brother who has gone to work in the town. The falling labour force on the farms that this situation more or less guarantees, plus the goad of foreign competition, means that the farmer and market gardener have as great a need as ever for the services of the agricultural machinery manufacturer.

At home the decline in this year's agricultural machinery sales, while not welcome for itself, will lend further impetus to the manufacturers' efforts to meet the needs of the farming industry.

Much of the progress in this field comes from the National Institute of Agricultural Engineering. A single example from the work being carried on by the Institute shows the close connection between the economic facts of farming and the design of the machines provided by the manufacturers.

A substantial part of the wages bill in horticulture still goes on hand hoeing along crops grown in rows. Accurate machine hoeing close to the rows can be done more quickly on a suitably designed tractor but there is a problem of the man on the tractor becoming quickly tired by the conditions of the job. The effects of vibration, steering effort and the maintenance of accuracy, as well as seating design, the field of vision and the best possible position for the controls are all being investigated with an experimental vehicle.

The Institute is equally active on problems of water supply and is working on the possibility of controlling greenhouse irrigation by the same artificial-leaf method as is now common for intermittent mist regulation.

Continuing its attention up to the end of the growers' activity, the NIAE is interested in the development of vegetable washing machines.

and the Pace of Change in Hovercraft Design

The last of the four United Kingdom companies working in the Hovercraft field has now announced the direction in which it is moving.

Folland Aircraft, a member of the Hawker Siddeley group, are to make a series of Hovertrucks, the first of them having a payload of 5 tons. Work is now in progress at Folland's factory at Hamble, Hampshire, on a demonstration model along Hovertruck lines to be known as the GERM (Ground Effect Research Machine).

What the GERM makes plain is that the pace of improvement and adaptation in Hovercraft is so rapid that the first to go into service will be greatly in advance of what has so far been demonstrated. It is almost certain that as the first such vehicles begin their commercial life there will already be in the development stage the Hovercraft that will supersede them.

It may be inescapable, but it is the fact, that the very intensity of research and engineering development that creates the first of this family of advanced transports shortens their useful life as it hurries on to create the next Hovercraft generation.

Already the GERM is capable of being modified to make use of recirculation systems for improving the efficiency of the air cushion, of more advanced methods of control and of side wall designs of the type that may be employed with Hovercraft travelling fast over water.

The Hovercraft industry, in addition to Folland of Hawker Siddeley, now includes Saunders-Roe of the Westland group, William Denny and Brothers, the Scottish shipbuilders, and Vickers-Armstrongs. (South Marston).

Liquid Fertilisers Increase in Popularity

Over-population must be combatted by voluminous food production. A recent UN report indicates widening use of liquid fertilisers and comments on their success in various parts of the world.

THERE is little doubt that fertilisers are the saviour of mankind. The Russian attitude has been summed up by A. V. Sokolov who writes in *Vestnik Akademii nauk* SSSR, 1960 (2), 33-37 (LLU translation): "The appropriate provision of the complex work on furnishing a scientific basis for the path to be pursued in the introduction of chemicals to agriculture, the widespread introduction and rational utilisation of the results of this work, the elimination of anything likely to inhibit the introduction of chemicals and its effectiveness, will already in the present seven-year period yield additional milliards of poods of agricultural produce." (1 pood equals 36 lb.)

"And what is the position regarding the introduction of the achievements of agrochemical science into the national economy?" asks the same author: "In 1965 the production of mineral fertilisers for agriculture will reach 30 million tons. . . . This amount of fertiliser will produce additional milliards of poods of grain, sugar, fibres, forage and other farming produce."

To the layman, for whose benefit, after all, all this deep thought is being expended, there immediately arise several far reaching questions such as:

1. How many million tons of fertiliser would it take to grow food in the Siberian desert?
2. If one knew the answer to how many million tons of fertiliser it would take to grow food in the Siberian desert, would the capacity of Russian fertiliser industry be sufficient to cover it?

It is perhaps only fair to Sokolov to add his down to earth estimate of the Russian fertiliser industry's present capacity as well as the 30 million tons which it will be after the five year plan of expansion: "i.e." he says, "it will be three times greater than in 1958."

AGRI/MECH/16 is the code number of a United Nations report which will be available shortly from HM Stationery Office, PO Box 569, London, SE1. It is entitled *Agricultural Mechanization: Mechanization of the Application of Chemical Fertilisers in the Form of Liquid.* This is the report of a working party and follows a series of earlier publications on such subjects as harvesting and conservation of green fodder in dry regions and milking methods and milking machines.

This UN report reviews the use of nitrogen fertilisers in the world and points especially to the increasing use of dilute solutions of ammonia. Mr. D. Machacek, director of the Institute of Agriculture Mechanisation in Vumez-Repy, Prague, who prepared this report, includes these comments on conditions in Eastern Siberia.

"Nitrogen fertilisers have proved to be particularly effective in the conditions of Eastern Siberia, largely owing to the peculiarities of the climate. The cold, dry spring and the considerable depth to which the soil is frozen are not conducive to the development of biological activity among the microorganisms of the soil. Thus, in the first stage of growth, the plants lack water and nutrients and suffer from the low temperatures of the soil and air. These peculiar conditions slow down the development of the plants in the first phase of growth (about 30 to 35 days before sprouting). Towards the end of June, the weather suddenly turns hot, the soil thaws and the rapid growth of the plants is stimulated by the summer rains. At this season, when the plants form 60 to 70 per cent of their whole organic substance within about 20 to 25 days, they are in urgent need of nitrogenous food, but there is not enough assimilable nitrogen in the soil to satisfy their requirements. The application of nitrogen fertilisers is therefore especially beneficial to the growth and development of crops."

Now that the layman's problem of growing food in Siberia has been clarified a little, perhaps we could revert to more domestic problems. To quote Sir Clavering Fison, writing in the *Financial Times* survey of chemicals: "Farmers are recognising that fertilisers are the key to higher yields and lower costs per unit of production. In fact, during the past two decades, the consumption of fertilisers in the UK has more than trebled. It is a startling increase [*cf.* the Russians' plan to treble production in five years] representing greater progress than in the previous 80 years' history of the fertiliser industry.

"More than 4 million tons a year are now being applied, supplying over 1 million tons of actual plant foods, nitrogen, phosphate and potash. . . . The use of nitrogen has increased to some five times the pre-war level, while that of phosphates, relatively higher before the war, has more than doubled." He then refers to a table shown here which indicates the consumption of the main fertiliser chemicals in the UK.

Fertiliser Consumption (in thousands of tons of plant nutrient)

	Nitrogen	*Phosphorus*	*Potassium*	*Total*
1957-58 ..	315·3	386·2	248·1	1,049·6
1937-38 ..	59·7	171·1	73·4	304·2
1927-28 ..	37·7	141·5	46·2	225·4

It should now be possible to put into better perspective figures quoted in the United Nations report which show consumption of ammonia water in the UK.

Increasing Use of Ammonia Fertiliser in the UK

Year	*Total area fertilised with 2·25 per cent ammonia water (in ha)*
1952	1,100
1953	3,232
1954	5,060
1955	6,600
1956	8,360
1957	11,440

The amount of ammonia water corresponding to the figure for 1957 is about the 2,000 tons level, which is itself highly dilute. Nevertheless, the rate of growth of ammonia usage compared with that of granular fertilisers is striking, so perhaps it is worth looking further at the conclusions reached by the UN working party on the value of liquid compounds instead of granular ones. The following passages are taken from this report.

Though the first research experiments on the effect of liquid nitrogenous fertilisers were conducted in the USSR and the United States (California) as long ago as the thirties, it was not until the post-war years that the rapid increase in their use occurred. What delayed their development was lack of mechanised equipment.

In all countries where the new methods of fertilisation have been tested, laboratory and field experiments to establish the crop capacity resulting from the use of liquid nitrogenous fertilisers have shown that ammonia is as good a nitrogenous fertiliser as the granular kinds. In most cases better yields have been obtained. The effectiveness of the nitrogen is increased if the ammonia is applied directly to the roots of the plant at a substantial depth, for then the plant gets the nitrogen when it is most needed and full nutrition is ensured, which is by no means always the case when granular fertilisers are used. The application of liquid fertilisers to the soil is combined with deep tillage, so that fertilisation and improved aeration are obtained simultaneously by a single agrotechnical operation. Ammonia produces the best results with between-row crops having high nitrogen requirements, particularly sugar-beet, potatoes, mangolds, seed grass, tobacco and cotton. In favourable conditions it may also be used as a fertiliser for oats, barley and forage mixtures. It may also be used for special crops such as hops, fruit trees and vegetables, especially the various kinds of cabbage.

WHY LIQUID, NOT GRANULAR

Direct application of nitrogen in the form of ammoniacal solutions means a big saving in capital investment, since it eliminates the need for the extra factory facilities which would otherwise be needed for the manufacture of granular nitrogenous fertilisers.

These fertilisers comprise anhydrous ammonia, ammonia liquid fertilisers, aqua ammonia and liquid manure.

Anhydrous Ammonia is a concentrated nitrogenous fertiliser, containing 82·3 per cent of nitrogen. At normal temperature and pressure, ammonia is a colourless gas with a characteristic penetrating odour. Liquid ammonia is stored in closed containers at calculated pressures, for the pressure of the vapours increases as the temperature rises.

The ammonia liquid fertilisers are aqueous solutions of granular fertilisers or solutions of granular fertilisers and ammonia. There are various kinds as follows:

Ammonium Nitrate Solution contains about 60 per cent of ammonium nitrate and 21 per cent of nitrogen. In cold weather, ammonium nitrate in higher concentrations precipitates. This solution can also be used as a surface fertiliser.

Solutions of Ammonium Nitrate and Aqua Ammonia contain from 35 to 45 per cent of nitrogen. The solution must be covered immediately after application to the soil in order to prevent the escape of ammonia into the air; and the same applies when anhydrous ammonia or ammonia water are used on heavy, silty soils.

Solutions of Urea and Aqua Ammonia contain from 36 to 45 per cent of nitrogen. They also must be covered immediately after application to the soil, to prevent ammonia from escaping into the air. These solutions cost more to produce than anhydrous ammonia, but the equipment for spreading them is cheaper, since no high-pressure apparatus is needed. The solutions develop no pressure at all, or just a little.

Solutions of Ammonium Nitrate and Urea for direct application contain about 32 per cent of nitrogen. Like ammonium nitrate, this solution can be used as a surface fertiliser.

Aqua Ammonia contains up to 30 per cent of ammonia (24·6 per cent of nitrogen) and 70 per cent of water. Aqua ammonia with 30 per cent of ammonia does not develop any pressure at temperatures up to 20° C and only a little at higher temperatures.

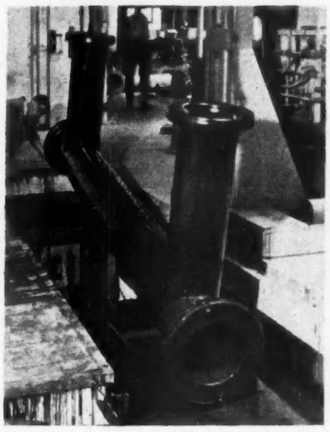
Aqueous Solution Containing Ammonia. At ammonia concentrations of 2·25 per cent this is a by-product of the scrubbing of gas at gasworks. This fertiliser is used for surface application only. It is not sprinkled or sprayed, however, as this would cause large losses of nitrogen; the solution is delivered through hoses directly to the surface.

Liquid Manure comes last among the liquid fertilisers. It has an average nitrogen content of 0·25 per cent. Obviously, therefore, it is not a concentrated nitrogenous fertiliser, but the hormones it contains stimulate growth, especially of crops which require hoeing.

Pvc Coating for Salt Water Pipeline

Those who read this section of the journal will be aware that although several firms can supply pvc piping in diameters up to 18 in, the properties of this plastic must be carefully considered so that a drainage installation has the required rigidity. For most applications 6 in will probably be the size people will choose as their maximum—until compounds with greater strength and rigidity are produced. Above this size, there is expensive reinforced plastic pipe or lined steel as alternatives to pitch-fibre, concrete or ceramic.

Here is an example of how to make good use of plastic coatings—a lined pipe for handling salt water. The people who did this are Plastic Coatings Limited who probably know more than most firms on what plastic coating to use on what application. Their activities include both plastisol and fluidised application (see ENGNG., 6 May '60, p. 604, for an article on the latter process). The illustration shows a 14 in diameter pipe emerging from a bath of pvc plastisol (pvc made liquid with plasticers) with



a coating thickness of $\frac{1}{8}$ in. In this instance it replaced a rubber lining. This pipe will now, as well as enjoying the corrosion resistance of pvc, offer a very much lower frictional force to water passing through it—for this is one of the outstanding characteristics of pvc piping. British Geon supplied the pvc resin.

Plastic Coatings Limited, Guildford, Surrey.

How to Increase Burst Strength of Tubing

Here's how two firms set about increasing burst strength of their rubber tubing. The first would perhaps not be a recognised technique by anyone not familiar with rubber processing but the second is sound common sense.

Smith's Motor Accessories eliminated metal braiding from rubber tubing used for fuel distribution on a combine harvester by incorporating a rubber compounding resin into the mix (the tube is illustrated). What is more, the introduction of these resins has increased the compound's resistance to petrol, oil and heat. Wall section has been decreased while yet retaining the same tube life. An added inducement to use a resin additive in the rubber mix was that the resin improves processing, speeds the mixing cycle and aids extrusion by reducing the die swell. Cellobond is the name of one family of these resins—made by British Resin Products.

Lockheed Hydraulic Brake Company and Girling looked to another sort of rubber reinforcement—fibrous. Between them, these two companies make over 90 per cent of all car brake assemblies in this country so when the supply position of cotton from the Middle East became uncertain they looked to a home source. What better than Terylene?

Cotton reinforced hoses had been tested by Lockheed up to bursting pressures of 8,000 lb per sq. in, which provided a considerable safety margin over the SAE minimum burst pressure requirement of 5,000. Terylene reinforced hoses are now being tested up to 12,500 lb per sq. in—well over double the requirement.

Cellobond Rubber Compounding Resins: British Resin Products Limited, Piccadilly, London, W1.
Terylene: Imperial Chemical Industries Limited, Millbank, London, SW1.

High Strengths in 3 mm Glass Sheet

Scientists working at the D. I. Mendeleev Institute of Chemical Technology in Moscow report on a new technique for bringing about an overall increase in strength of glass by combined chemical and thermal treatment. Results of their experiments suggest the possible replacement of metals by glass as structural material, since the bending strength of glass treated by this new method becomes greater than that of certain widely used steels.

Experiments were carried out with industrial sheet glass, which was first softened by heating in a furnace to 200° C, and then quickly immersed in a heated organosilicon liquid bath. Hardening was achieved by constant decreases in temperature of the organosilicon liquid in steps of 20° C. The glass specimens were then removed from the bath and dried at 200° C, since higher temperatures bring about considerable relaxation of the stresses established in the glass.

This process was found to increase bending strength of 3 mm thick glass by as much as 11 times—to 77,000 lb per sq. in—while with thicker glasses the bending strength was increased by an even higher ratio. This marked increase in strength is due to the simultaneous hardening of residual stresses, and formation (at the moment of quenching) of a silicon-oxygen polymer which heals the microcracks in the glass surface. It is interesting to note that the internal residual stresses produced in this way are only slightly greater than those produced in the normal hardening of glass in air. It is therefore evident that the success obtained depends on the nature of the polymeric film formed, which acts as a unique "armour," cementing the glass surface.

Proc. *Academy of Sciences of the USSR, Chemical Technology Section (translated by Consultants Bureau, New York, USA).*

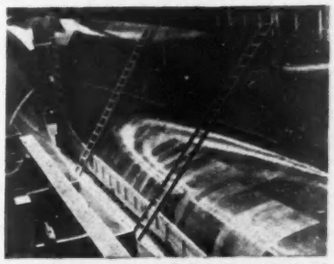
Come to Britain for Plastic Boat Hulls

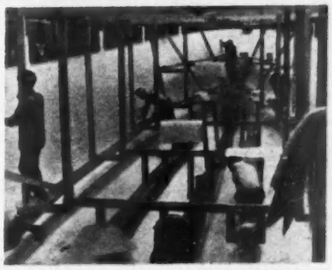
Mr. Virgil Browne—a Coca Cola "King" from Oklahoma—would be very naïve if he didn't realise the implications of his coming to England to have a 67 ft long ocean cruiser made for him by Halmatic. For that is what has happened. Why did he take this step, for the Americans are seemingly far more advanced than we are in exploiting mechanised spray guns in place of hand lay-up for making reinforced plastic boat hulls? It probably boils down to cost, but it was obvious when this particular hull was removed from the mould last week that both internal and external finish were to a very high standard.

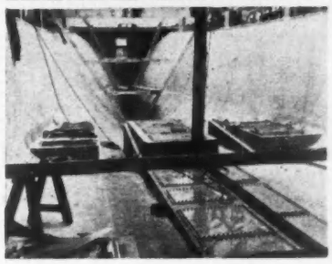
In the top illustration you can see one half of the veneer faced mould which is still shiny with wax parting compound. There were two other moulds: the twin sister, and one for the transom. Below that are some of the ten laminators at work on the external skin which has an average thickness of just under $\frac{1}{2}$ in. At the bottom is a view of water and fuel tanks which are moulded on to the hull in plastic with only a single outer skin of normal thickness. Tin-coated steel bolts hold down aluminium covers on these tanks.

The hull, ready for fitting in an American boatyard will cost £10,300 including one-third of the mould cost of £5,000 (this is high, but Mr. de Laszlo, director of Halmatic, hopes to build up to six a year in the same mould) Timber hull construction would have cost around £12,000.

Fire and strength tests were "more than satisfactory" to Lloyds, and plastic fuel tanks have







been reluctantly accepted by American authorities. At 67 ft length, this is probably the largest plastic hull in the world, so with its saving money, this construction will probably be the first of many.

Halmatic Limited, Portsmouth.

Fertiliser Expansions

A £1 million extension to one of Britain's largest fertiliser factories at Immingham in Lincolnshire will enable the production of phosphoric acid to be stepped up as from June, 1961, it is announced by Fisons.

Ammonium phosphate will also be manufactured for the first time following modifications to a plant now producing triple superphosphate. It will be distributed to Fisons fertiliser plants throughout Britain where it will be used in the manufacture of high analysis compounds.

These modifications will lead to greater efficiency in manufacture and also enable the farmer to be provided with fertilisers of higher plant food concentration.

In addition, quayside operations will be speeded up at Immingham and the rate of turn-round of shipping increased by the installation of additional cranage and modifications to the raw material intake system. Storage for phosphate rock will also be increased.

These developments follow little more than a year after the opening of Fisons ammonium nitrate factory on the Thames Estuary at Stanford-le-Hope, which was built as part of a £4·3 million scheme.

Fisons Fertilisers Limited, 95 Wigmore Street, London, W1.

Plain Words

By Capricorn

AMONG the bringers of light relief during the Second World War—and there were some famous ones, ranging from Churchill's astringent comments on the Nazi leaders to Tommy Handley's It's That Man Again—was a cheeky little gimmick which allowed infinite variations on the theme "What—no eggs?", or whatever was the current and most maddening shortage afflicting the home front. The words were always accompanied by a simple sketch showing in outline a bald head peering over a wall, hands clutching the top bricks as though the owner were a prisoner, and the nose hanging over in a not-to-be-ignored way. The little fellow can express very neatly the feelings induced in me by all this talk of food: I put into his mouth the words "What—no spending guide?"

What is a spending guide? Let me explain. I have been searching for a book that will guide the wise and prudent householder in the allocation of his money. Even in the welfare state, there is still a part of your income that you can call your very own and that you can allocate in various ways according to your tastes and inclinations. And if you have acquired some capital there are endless possibilities in juggling with all the variables: income, capital, investments, insurances, hire purchase, overdrafts, annuities, renting or buying your house, living strictly within your income, mortgaging a bit of the future . . .

As a non-financial type I find this wealth of choice fascinating but confusing. I long for a textbook that will give me the basic equations, even if I have to guess the values to put on the constants. In short, I want a spending guide.

There ain't no such thing. At least I have been unable to find one with the help of a fine public library (Westminster) and a fine book shop (The Times). In both cases the staff were very helpful but they could only produce the odd chapter in a book on something else. One of my helpers suggested that really it was only common sense.

Maybe he's right, but if he is we are all extraordinarily lacking in that common quality. I am myself, anyway. Never was so much attention given to ways of earning and making money—we spend the best years and hours of our lives doing that—but there is practically nothing on ways of spending money apart from the hysterical advertisements of the manufacturers. And they do tend to be biassed.

To get to the heart of the matter, I prefer to cut out all references to "money." Although it is a convenient common denominator for concepts like "work," its use clouds the real issue. The real issue is that we are marvellous at making things that people want, and we are also rather cunning at making people want the things we make, but we are like children in deciding what we want.

Letters to the Editor

For Feeder Services —Airships

SIR, I read, with great interest, the article by Mr. B. G. Bodroghy concerning "Airships for Noiseless Feeder Service" (ENGNG., 22 July '60, p. 124), and it does appear that there is one possibility which has been overlooked in his considerations. This is the use of compressors to pump the lifting gas into cylinders, and hence reduce the lift available to the airship by the amount required to change from "light flying" to "neutral or heavy flying."

It would seem that there are two possible methods of using this, either by incorporating compressing plant into the airship, and thus enabling it to change density while in flight, which would undoubtedly incorporate a weight penalty; or alternatively, by using compressing plant at the airport only and having a store of helium at the city terminal. If this technique were used, the airship could fly light from the city terminal to the airport and land by using its engines for negative lift, where the gas would be compressed into cylinders by ground equipment and the now heavy airship flown back to the city terminal.

This would, of course, mean an effective transport of helium from the city terminal to the airport, but the cylinders of helium could undoubtedly be returned in the airship on flights when less than the maximum number of passengers and luggage were being carried.

Yours faithfully,

JOHN C. MAWER.

Flat 4, Colton House,
Colton, Near Rugeley,
Staffordshire.
18 August, 1960.

Who Pays Development Costs?

SIR, I was very interested in your editorial comments on footing the bill for development (ENGNG., 12 Aug. '60, p. 201).

It seems to me that there are several issues involved. Firstly, it matters considerably whether the manufacturer is in possession of the data required for anticipating demands or whether these data can only be supplied by the consumer. As a case in point I quote the steel industry. A maker of electronic-control equipment can hardly foresee the developments in the control of rolling mills, etc., and consequently, the steel firms themselves have to engage in research and development, perhaps by associating with the electrical industry as in the case of AEI-Davy United.

But the case which I should like to single out as particularly important is the one where the consumer is a Government monopoly. Industry, in this case, is completely dependent on Government policy and decisions, and the profits are largely made by the Government. This is the case with equipment for the Post Office, and it seems fair that the Government should foot the bill for research and development costs. In the field of nuclear power, the Government has in fact done so. The British Electricity Authority are beginning to realise their obligations and the National Coal Board have been financing development costs for machinery to a large extent.

In the field of communications the Government maintains, in addition to the research facilities of the Post Office, several excellent research organisations: Services Electronics Research Laboratory, Radar Research Establishment, etc. For defence purposes, development contracts based on basic work by these organisations have been given to industry by the Coordination of Valve Development Committee (Admiralty); in the past on a cost plus basis. Radar is in danger of becoming obsolete in the rocket age, and contracts in this area are diminishing. The Government has all the scientists and facilities it needs to set up a Telecommunications Corporation which could give development contracts to industry for peaceful purposes.

There is also a national interest at stake. Our own home market in telecommunications does not have the same need for long-range communication systems as the American one does. If Britain is to keep a share of the markets which are bound to develop in Africa, Australia, etc., we shall have to plan boldly for overseas needs and spend more money than the firms can afford on their earnings from a sluggish home market. A Government Telecommunications Corporation would be in a position to do just that. Eventually, the Government might also be in a better position to obtain contracts for running communication systems abroad than private firms are and will be. The firms would be glad to offer their manufacturing capacity. In a field like communication by means of satellites, or long-distance millimeter-wave telephony they can hardly act without Government guidance.

Yours faithfully,

H. MOTZ,
Donald Pollock Reader.

Engineering Laboratory,
University of Oxford,
19 Parks Road, Oxford.
19 August, 1960.

Concrete Vibrators

SIR, In a recent issue, under the heading of "Operation and Maintenance," I take interest in a short note entitled "Longer Life for Concrete Vibrators" (ENGNG., 29 July '60, p. 157).

In my capacity as manager of the Vibration Department of Winget Limited this is a problem which I am constantly investigating and I should like to make the following comments.

You state that the most frequent causes of wear in poker type concrete vibrators are the external shocks transmitted to the poker when vibrating. This, of course, is incorrect. The wear taking place on the outside of the nose cap of the poker vibrator is caused by radial gyration of coarse aggregate particles which, in time, wears down the outer surface. To overcome this problem there is only one answer and that is to use high quality abrasive resisting steel for the manufacture of nose caps.

We ourselves introduced rubber nose caps some six years ago. The object in making these available for the users of poker type vibrators is to avoid damage occurring to moulds and shuttering by the steel nose caps when vibrating concrete in restricted areas. These nose caps in no way assist to increase nose cap life.

Yours faithfully,

J. D. LATHAM,
Manager, Vibration Plant Sales.

Winget Limited,
Rochester, Kent.
12 August, 1960.

Internally Ribbed Tube

SIR, I should be grateful to be allowed to correct one or two false impressions created by your article: "Internally Ribbed Tube Made by Rolling" (ENGNG., 5 Aug. '60, p. 170).

The type of ribbed-bore tube produced by a rolling process in this country is not manufactured by the Weldless Steel Tube Company Limited, but by Tubes Limited at their Eagle Works, Kirby Muxloe, Leicestershire, where, incidentally, the production of ball-bearing tubing commenced in June, 1954, and not last year, as stated by your contributor.

The majority of inquiries for Tubes Limited's ribbed-bore tube have until now been concerned with heat exchangers, the working conditions of which have required only low-carbon steels. These tubes have, however, already been produced in the low-alloy "creep-resisting" steels. In these steels the advantages of ribbed over

plain bores are even greater than in the carbon steels. Successful production trials have also been carried out with high-alloy and stainless steels.

While it is not possible under present conditions to quote quick deliveries, the capacity position is not as limited as your article seems to imply. Considerable quantities of ribbed-bore tube are now being made, and while the manufacturing process does not lend itself to very short runs, it would be comparatively simple to meet additional demands for the bore profiles now in production. It would, however, require detailed planning to fit different bore profiles into existing production programmes.

Yours faithfully,
J. SCOTT,
Director.

Tubes Limited,
Aston, Birmingham 6.
16 August, 1960.

Hydraulics at Colleges

SIR, We were very interested to note the letter from Mr. Herbert Addison regarding the inclusion of hydraulic laboratories in British colleges (ENGNG., 29 July '60, p. 140).

We are very pleased to inform Mr. Addison and your readers that we have been instrumental in the recent months in equipping a complete oil hydraulic laboratory at the Leicester Technical College and are also at present supplying complete structures to the new Lanchester College of Technology at Coventry.

These structures are of the type that clearly shows to the student the method by which pressurised oil flow can be used as a power medium for obtaining rotating and reciprocating motions. Being of an open-work type, the structures clearly show the layout of pipelines, simplicity of controls and also show sensitive systems such as used for copying controls and servo-assisted units.

We only hope that such a trend will be followed by other institutes of technical teaching throughout the country, as quite obviously the knowledge of oil hydraulics as a source of power is something which engineers in this country are sadly lacking when compared with overseas engineers, particularly when referring to the machine tool industry.

Yours faithfully,
J. GODSELL.

Keelavite Hydraulics Limited,
Allesley,
Coventry, Warwickshire.
18 August, 1960.

Appreciation of Design

SIR, Mr. S. C. McKenzie suggests in his letter that we might occupy our holiday moments with the " provocative and not too laborious exercise " of thinking about " the realm of artistic adventure as an antidote to the strictly utilitarian training of a formal technical education" (ENGNG., 29 July '60, p. 140). Would he allow me my vacation for other purposes? Perhaps a few not too laborious engineering exercises for at least some of my working time is spent on just such thinking as he recommends.

I would hestiate to use the word " antidote " however. Ought we not to say " addition "? We may have to use it in the supplementary sense at the moment but why should we not look towards engineering training systems which incorporate the " stimulus for original thinking " with the acquisition of technical expertise?

If this is something for the future, Mr. McKenzie may be interested to learn that the proof that a wider appreciation of design can be highly stimulating was provided by a course for young engineers held by the Council of Industrial Design at the end of 1959. In fact this design appreciation course was so successful that it is to be repeated this year—not during a holiday period.

One other small hesitation. Mr. McKenzie refers to the " subconscious fantasties " of Mondrian and Ben Nicholson. This is not strictly fair. Both artists were not concerned with painting from the subconscious but with composition. Their work is therefore highly " conscious " and very well worth the study of designers who want to see how mass and colour can be used to direct attention to the important areas of their machinery.

Yours faithfully,
W. H. MAYALL,
Industrial Officer (Engineering).

The Council of Industrial Design,
The Design Centre,
Haymarket,
London, SW1.
16 August, 1960.

National Water Grid

SIR, One cannot but admire Mr. J. F. Pownall's energy and pertinacity. It is now very many years since he first outlined his scheme—an outline quickly followed by contour maps and sets of figures showing the feasibility of his ideas. It is sad, alas, that as in so many other matters, the delay in the adoption of even a part of his scheme has resulted in very greatly increased costs. It is true that during the war it was virtually impossible to do anything of this kind, but one suspects that the 1942 estimate of £150,000,000 would now be nearly four times that figure.

Nevertheless, at a time when the water supplies of this country, whether for industry, agriculture, or human consumption, are receiving so much and urgent attention, it is to be hoped that Mr. Pownall's scheme would at least be before the body charged with considering future water supplies.

The Inland Waterways Redevelopment Advisory Committee is aware of Mr. Pownall's scheme, but from the national water grid angle it is outside the scope of the committee.

Even in these days of spending millions, the cost of the whole scheme may well prove, for some, a deterrent for an enthusiastic examination of the scheme's advantages. It seems to me that in the light of the present transport and water situations, it is very urgent that those concerned with such, as well as of course, the drainage authorities, should have another look at the project, and see whether some, at least, of their present difficulties can be ameliorated by the construction of this or that section which would finally, if required, form part of the splendid whole.

Yours faithfully,
GEOFFREY LOWLES.

Binfield Manor,
Binfield, Berkshire.
12 August, 1960.

SIR, With reference to your special article " Contour Canal for National Water Grid? " by Mr. J. F. Pownall (ENGNG., 15 July '60, p. 82), we would like to draw your attention to a printing error on page 83, bottom paragraph in the right hand column, where it is stated " For this there is available the Ranney Collector for drawing unfiltrated water from gravels . . ." This should of course read " infiltrated " water.

It occurs to us that in reading this article the word printed as " unfiltrated " might be misunderstood by some as " unfiltered," whereas in fact the gravels act as a natural filter to remove turbidity, etc.

As natural filtration is an essential feature of the Ranney Method of Water Supplies it is of some importance to us that this unfortunate error should, if possible, be acknowledged and corrected.

Yours faithfully,
W. A. GUNN.

Ranney Method Water Supplies Limited,
12 Queen Anne Street,
London, W1.
18 August, 1960.

Events in Advance

Science and Technology of the Food Industry

PREPARATIONS are already in hand for London's First International Congress of Food Science and Technology, which is due to take place in just over two years' time.

The scientific programme of the congress has been divided into six sections and will cover every aspect of the science and technology of food. Four of the sections will be subject groups and will cover, respectively, chemical and physical aspects; biological and microbiological aspects; the quality, analysis and composition of food; and engineering and presentation problems. The fifth section will be concerned with food and the consumer, and the sixth section will discuss questions relating to the training of food scientists and technologists. It is the organisers' intention that, from within the very wide field covered by these six groups, topics shall be selected for discussion on the basis of " their novelty, timeliness and breadth of interest."

An outstanding feature of the occasion will be the number and scope of the visits which are being planned. These will be made to research and educational establishments concerned with various aspects of food and to food-manufacturing organisations, in various parts of the country. They will take place before, during and after the congress. An opportunity will be provided during the congress for discussing the setting-up of a permanent international organisation for the furtherance of all aspects of food science and technology. Efforts are being made to attract a large and representative attendance from overseas countries as well as from interested parties in Britain.

Lord Rank of Sutton Scotney has been appointed President of the congress. An executive committee has also been set up, under the chairmanship of Professor H. D. Kay, C.B.E., F.R.S., the other members of which are Dr. A. J. Amos, Dr. E. C. Bate-Smith, Mr. A. P. Buchanan, Dr. J. B. M. Coppock and Mr. F. J. Monkhouse. Lieutenant-Colonel Francis J. Griffin, 14 Belgrave Square, London, SW1, is the honorary secretary. A preliminary programme of the congress, which will be held from 18 to 21 September, 1962, is expected to be issued in a few months' time. Copies of this publication and any further information desired may be obtained from Colonel Griffin.

Exhibitions and Conferences

Nutrition, Fifth International Congress on.—Thurs., 1 Sept., to Wed., 7 Sept. in Washington, D.C., USA. Organised under the auspices of the International Union of Nutritional Sciences, the American Institute of Nutrition, and other organisations. Apply to the secretariat of the Congress, 9650 Wisconsin Avenue, Washington 14, DC, USA.

Food Fair, The 1960.—Thurs., 1 Sept., to Sat., 17 Sept., at Olympia, London, W14. Organised by the Food Manufacturers' Federation Inc., 10 Mount Row, London, W1. Tel. HYDe Park 2933.

Institute of Metals, 52nd Annual Autumn Meeting.—Mon., 5 Sept., to Fri., 9 Sept., in Bath. Offices of the Institute: 17 Belgrave Square, London, SW1. Tel. BELgravia 3291.

Preserved Food and Packaging Exhibition, 15th International.—Tues., 20 Sept., to Fri., 30 Sept., in Parma. In Great Britain, applications should be made to the Italian Chamber of Commerce for Great Britain in London, 31 Old Burlington Street, London, W1. Tel. REGent 2411.

Groceries and High-Class Provisions, International Exhibition (IKOFA).—Fri., 23 Sept., to Sun., 2 Oct., in Munich. Apply to Verein Ausstellungspark e.V., 14 Theresienhoehe, Munich 12, Germany.

Food and the Home (Arts Ménagers), International Exhibition.—Sat., 1 Oct., to Sun., 16 Oct., in Brussels. Organised by the Société Cooperative des Industriels et Commerçants en Materiel et Produits pour l'Alimentation, 8 to 10 Place de Brouckere, Brussels.

DISPENSERS

Hot and Cold Drinks

NEW versions were recently introduced of two dispensing machines, the Hotspa and the Colespa, for hot and cold drinks, respectively.

Each machine in the "60" series is capable of supplying seven different drinks.

Both machines are fully automatic in operation and make each drink separately. Filling disposable cups, service can be at the rate of one drink every seven seconds. Connections are required to electricity and water mains.

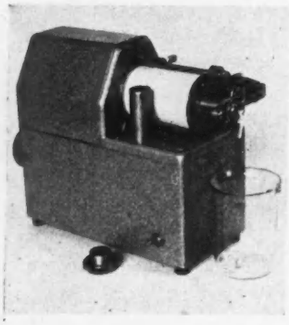
It is claimed for the new models that the coin mechanism has been improved and that the cup drop mechanism is also better. It is now possible to dial the size of cup desired. The capacity is for about 1,000 cups, according to size. Normal electricity supplies of 240 V 50 cycles are used, the maximum demand being 2 kW. A minimum water pressure of 25 lb per sq. in is needed, the internal pressure being controlled by a break tank and pump.

The cabinets stand 5 ft 8 in high by 2 ft 1 in wide and 2 ft 4 in deep. Coin mechanisms are for 3*d*, 6*d*, 1*s*, giving change if desired. The stainless steel containers hold 1½ lb coffee, 6 lb sugar, 4½ lb milk, 6 lb chocolate, and 4½ lb of each soup. The cups are of 7 to 10 fluid oz capacity.

Many features of the Colespa are the same as those that are fitted to the Hotspa, the capacity for each ingredient being 2·6 gallons or 400 drinks. Both have a "soldout" device to prevent use when the cup supply is exhausted. A smaller machine is the Minispa, which will supply up to 200 cups. *Ditchburn Vending Machines Limited, Dock Road, Lytham, Lancashire.*

TEXTURE RECORDER

for Spreadability



THE texture of any material that can be forced through an orifice may be measured on the FIRA-NIRD extruder. Though originally devised for work on the consistency of butter, and used for investigations into the rheology of margarines and compound cooking fats, its use is in no way restricted to the food industry. It has already found its way into the laboratories of explosive manufacturers.

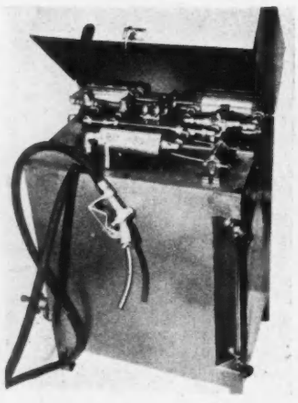
The instrument is used to force the material under test through an orifice at constant speed. During this operation the thrust required to extrude the material is continuously measured and recorded on a paper chart which then provides a permanent record of the behaviour of the material throughout the test. The smoothness of the trace is an indication of the smoothness of the material. In the case of butter or table margarine the final reading of the thrust is closely related to the "spreadability," as assessed by subjective tests; corresponding properties of workability could be deduced for engineering materials. The area under the curve is a measure of the work done during extrusion.

Materials with a very wide range of textures can be examined by changing the calibrated leaf spring used in the instrument.

The original design of the instrument was the work of Mr. J. H. Prentice of the National Institute for Research in Dairying (NIRD). *H. A. Gaydon and Company Limited, 93 Lansdowne Road, Croydon.*

BLENDING MACHINE

For Liquids



A RECENTLY introduced blending machine is designed for the mixing and delivery of two or more liquids.

The model illustrated is intended for filling car radiators with a mixture of water and anti-freeze. It will deliver in proportions varying from 84/16 to 67/33 by micro adjustment of the cylinders. A later model incorporates a third section for adding 3 parts in 100 of soluble oil.

Power for these units is supplied by pressure in the water mains. This drives the water-measuring cylinder which in turn drives the other cylinders, the various liquids being stored separately. Alternatively air pressure can be used as the driving force. If the supply of any one liquid becomes exhausted, then the unit is brought to a standstill by means of interlocks. Liquids can be fed to the reservoir compartments by pump or gravity. Any chosen proportions can be arranged by selection of suitable cylinder sizes and by adjustments.

All liquid handling cylinders are in brass, and castings, fittings and valves in bronze. Pipes and fittings are in galvanised steel or copper. The tanks are welded mild steel internally treated with alcohol resistant dressing. For inflammable liquids all electrical contacts can be eliminated. *Suba Hydraulics Limited, 86 Lind Road, Sutton, Surrey.*

ROTARY FEEDER

Air Operated

A TWIN table rotary feeder has been introduced primarily for use with the Netlon packer but suitable for many other applications.

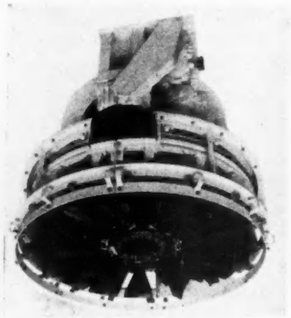
The two tables are mounted one above the other and are driven by the same shaft from an electric motor. The items to be handled (the illustration shows fruit, but any light weight relatively small items or components can be handled equally well) are emptied on to loading trays at the back of the feeder. These trays are then elevated to feed the turntables. As the turntables rotate the items pass a jet of air from a tube which blows them into the delivery tubes. This reduces the stresses of handling and avoids bruising. The air is supplied from a small compressor at the side. The feed tubes can be arranged to deliver the items wherever they are wanted.

In the illustration the two tables feed the two work heads of the Netlon packing machine. A tube of plastic netting is slid over the delivery tubes and the end heat-sealed in the machine. The seal is cooled by air from the same compressor. The fruit is fed down the tubes into the net and cut off in groups of a chosen number. While the seal and cut is being made on one head the operator is loading the net on the second head. Sealing takes about two seconds.

The feeder operates from a 220-240V supply with a consumption of about 900 W. *Spicers Limited, 19 New Bridge Street, London, EC4.*

VACUUM FILTER

Rotary Table Type



A RECENTLY introduced rotary table filter is capable of handling widely different materials such as caustic lime slurry, brewer's mash, and oil seed pulp among others.

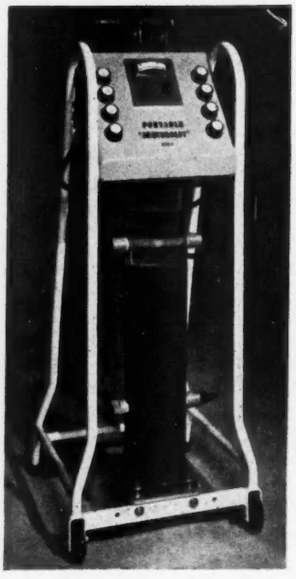
The filter is made in several materials, including stainless steel, and offers several stages of cake washing during one cycle. It can be fitted with a vapour tight hood for use with volatile liquids. The filter is intended for use with the quick settling types of slurry and the final product is clean cake containing as little as 6 per cent moisture. It is claimed that it will overcome some difficulties which are commonly connected with abrasive materials.

A series of radially disposed trays with perforated bases and replaceable filter cloths revolve horizontally on a vertical ported trunnion. The hoppers are filled from overhead feed pipes with a slurry kept in agitation at a pressure of about 20 lb per sq. in. During the cycle of rotation the sediment in the slurry is formed into a cake by being drawn against the filter medium at the bottom of the tray and is washed and emptied once in the course of each revolution of the table.

Each of the trays used forms a separate compartment or cell to which vacuum from the valvehead is applied through the central trunnion; the latter also serves as a drainage channel for the wash and filter liquids. *Davey, Paxman and Company Limited, Standard Ironworks, Colchester.*

WATER PURIFIER

Very High Quality



THE Mark 6 Deminrolit is a portable water purifying unit capable of handling up to 12 gallons per hour.

The demineralised water produced has a conductivity of less than 1·0 reciprocal megohms per centimetre, which conforms to the standard specified in the British Pharmacopoeia. The unit works on the mixed bed principle using Zeo-Karb 225 and De-Acidite FF.

Regeneration can be carried out on the spot in a simple and reliable manner. A conductivity tester is fitted which monitors the treated water continuously. Constructed as a free standing unit the plant is suitable for workshop as well as laboratory conditions. It is robust and non-corrodible. No expensive plumbing is required, the connections being made simply by a length of flexible hose. The unit is mounted on a trolley with wheels at the front. At the top is the control panel with the valves for operating and regenerating. *Permutit Company Limited, Gunnersbury Avenue, London, W4.*

CRANKSHAFT LATHE

44 in Centres

A TURNING lathe has just been completed for machining large crankshafts between centres.

The machine has right and left hand headstocks with a central head which supports and drives the work near the cutting position. The left hand head is fixed and the right movable both by hand and rapid power traverse. These heads have large diameter steel spindles revolving in parallel capped bearings with heavy duty ball thrust washers taking the thrust in both directions. The left-hand head has an adjustable shoot with positive locking.

The drive to the face plate is by single helical reduction gears and the pinion on the shaft has capped bearings enabling the heads to be removed from the bed without withdrawing the centre shaft. All bearings are one shot lubricated from a central position.

The faceplates are 7 ft 3 in diameter and bolted to a solid flange on the spindle. They have T slots and provision for independent chuck jaws. With the

latter it is possible to use either headstock as a large facing lathe. A compound toolpost can be fitted. All three heads are driven by a 6½ in diameter centre shaft which is approximately 40 ft long and forged and turned in one piece. It is driven by a 50 h.p. variable speed motor through a three speed gearbox, giving a total speed range from 1·8 to 50 r.p.m. Pressure lubrication is used.

A heavy duty feed box gives 12 feeds to the saddles from 4 to 192 cuts per in. Rapid traverse is supplied by a 10 h.p. motor. The bed, which was cast in two sections, is 7 ft wide and has a narrow guide for heads and saddles. There are cast-in chutes for swarf disposal. The machine will swing 44 in diameter over the bed and take 28 ft between centres. *Henry Broadbent Limited, Sowerby Bridge, Yorkshire.*

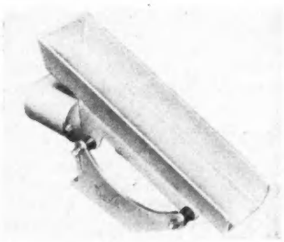
VIBRATORY FEEDER

Controlled Rate

THE model FV magnetic vibratory feeder has controlled rates of feed up to 10 tons per hour with an 8 in wide tray.

The machine differs from other types in that the magnet is attached to the tray and not to the base. The tray itself is made of cast aluminium which can be made thick to maintain stiffness while yet remaining light. As a result the base members have also been reduced in weight.

The aluminium stands for the machine are two castings which can be reversed for floor or ceiling mounting. The use of castings has reduced the production cost. The tray is fitted to the two stands by four antivibration rubber mountings so that the feeder can be incorporated as an integral part of a system. When hung from the ceiling only four tie rods or straps are needed, there being fixing holes in the stands for this purpose. The tray fixings provide for an adjustment of 10° in the angle of mounting.



The whole vibrator unit is entirely enclosed in a dust proof non-rusting casing. The tray can have coatings of plastic or stainless steel to enable corrosive materials to be handled and it is claimed that the angular fixing causes the feed to flow with an action that reduces wear to a minimum. Several sizes are made.

A controller is supplied with the unit enabling feed rates to be adjusted over a wide range. For the 8 in size mentioned the rate can be reduced from the maximum of 10 tons per hour to 1 lb per hour with a delivery over the full width. *Magco Limited, Lake Works, Porchester, Hampshire.*

MULTI-RANGE METER

High Sensitivity

THE new Multimeter model 105a has been designed as a robust inexpensive measuring instrument with a high sensitivity.

The instrument has a sensitivity of 20,000 ohms per volt and a total of 21 self-contained ranges. It is robust enough to withstand all normal hazards of every day usage in the shop or laboratory. There are six current ranges available from 60 μA (using the 3V d.c. setting) to 600 mA on the switch, and 12A on a separate terminal. D.c. volts have seven ranges from 0·3 to 300 on the switch and a separate terminal for 1,200V.

For a.c. there are five ranges covering from 12 to 1,200V and there are three resistance ranges from 0 to 20 megohms, self contained.

The scale is 5 in long and is calibrated in three colours to facilitate reference to the ranges. A decibel scale is included. Sensitivity for d.c. readings is 20,000 ohms per volt with an accuracy of 2 per cent full scale deflection, and 1,000 ohms

per volt on the a.c. ranges with an accuracy of 3 per cent full scale. A rugged centre pole movement is incorporated. The instrument dimensions are 8¼ in by 7½ in by 4½ in and the weight is 4½ lb. *Taylor Electrical Instruments Limited, Montrose Avenue, Slough, Buckinghamshire.*

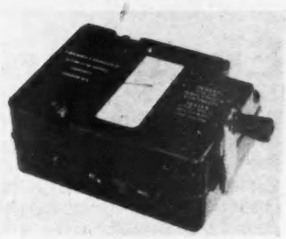
INSULATION AND CONTINUITY TESTER

Easy Operation

ONE of the claims for the recently introduced series 3 Megger is the light effort required for turning the handle.

The instrument is fitted with a true ohmmeter movement so that adjustment before use is not necessary. Calibrations are in international markings so that it can be used directly anywhere by unskilled personnel. In addition to the insulation testing range, the instrument will operate over a continuity range from 0 to 100 ohms permitting readings as low as 0·1 ohm or less by interpolation. The voltage for continuity testing is obtained from a 4 volt miniature generator so that no battery is required.

The effort required to turn the generator handle has been reduced by using the inherent characteristics of the generator and measuring circuit, so that a separate stabilisation network is dispensed with and the load on the generator correspondingly reduced. A clutchless nylon gear train transmits the torque



to the generator, giving smooth and consistent operation. Voltage/handle speed and voltage/load characteristics meet the requirements of both British and foreign specifications.

Three ranges of instrument are available. The 500 V pressure version covers from 0 to 100 megohms and infinity for insulation testing and from 0 to 100 ohms for continuity; the 250 V instrument up to 50 megohms and 100 ohms; and the 100 V model up to 20 megohms and 100 ohms. The case measures 5¾ in by 4 in by 2¾ in and the weight is 2¾ lb. Four patterns of carrying case are available. *Evershed and Vignoles Limited, Acton Lane, London, W4.*

DE-REELER

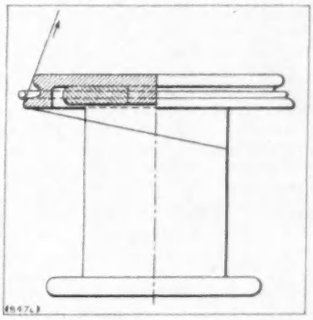
For High Speed Operation

THE Biflaker is a device for controlling the de-reeling of copper wire of small diameter from a long traverse vertical reel.

The device consists simply of a precision engineered metal disc resting on the top of the long traverse reel. Fitting in the lip of the disc is a metal ring under which passes the wire to be paid off. By virtue of the weight of the ring, tension is applied to the wire during the de-reeling which is particularly important during the acceleration and deceleration periods that regularly occur during coil winding operations.

During deceleration, the ring prevents the wire overrunning so that the wire never slackens off and falling turns do not occur. During acceleration, there is never any initial slack to take up and therefore snarls are avoided. Thus the two major hazards of flaking are successfully removed.

With this device, there is no necessity for any restraining of the wire, as it leaves the reel for there is no tendency



for the wire to balloon outwards from the reel. As a result, the wire can always be seen and it can be estimated if there is enough left on the reel to complete the winding. The Biflaker is designed for reels carrying up to 60 lb of wire in the size range from 0·0044 in to 0·0124 in diameter. It is simple to understand and to fit, and is robust. *British Insulated Callender's Cables Limited, 21 Bloomsbury Street, London, WC1.*

FIRE EXTINGUISHER

11 ft Range

A SMALL size carbon dioxide type fire extinguisher has a range of 11 ft in still air.

The model 1505 has a capacity of 5 lb of carbon dioxide and is complementary to the larger size which has a capacity of 10 lb. At the full mean range of 11 ft the discharge cone is 4 ft diameter; the discharge lasts for 65 seconds at a temperature of 65° F. The unit is primarily designed for close quarters work and when used by an inexperienced operator will put out a liquid fire 6 ft square. An experienced fire fighter can extinguish one 9 ft square.

The extinguisher weighs 19½ lb, hence it can be handled by most people. It can be reloaded on the spot in 60 seconds by any competent person. It has been approved by the Ministry of Transport (Marine Section) and also by bodies in Switzerland and Austria. The advantages of carbon dioxide over dry powder are that there is no residue, it can penetrate into places where other materials cannot reach, and does not damage

chemical or electrical apparatus. In use the extinguisher is held upright as shown. *Nu-Swift Limited, Elland, Yorkshire.*

Engineering Must Cater for New Appetites

Current trends in food supply and demand offer great scope for technical ingenuity. Engineers are likely to assume increasing responsibility for food production, processing, distribution and presentation.

By A. J. Carrington

BEFORE the war purchases of food accounted for about 29 per cent of all personal expenditure and in 1959 the proportion was about 31 per cent. During this interval real income per head has increased by something like 19 per cent. The calorie level per head represented by supplies moving into consumption has increased by about 5 per cent. Expenditure on food at the present time would probably represent about 28 per cent of total personal expenditure if the pattern of our eating were the same as before the war, with quantities increased by 5 per cent to allow for the additional calories. In fact, however, the proportion of our personal expenditure devoted to food is about one-tenth above this level.

The first clue to the nature of the change is the 15 per cent increase in the level of animal protein consumption per head of the population, animal protein being a form of food which is relatively expensive per calorie. Before the war some 62 per cent of our animal protein was produced in the United Kingdom. The volume of agricultural production has risen by 68 per cent and some 72 per cent of our increased animal protein supplies is now produced in the United Kingdom. We are now consuming 41 per cent more milk, 18 per cent more eggs, and 2 per cent more meat per head. All of our milk, nearly all of our eggs, and much more meat than before the war are produced at home with 8 per cent fewer agricultural workers than before the war. The improvement in the quality of livestock, varieties of seeds, the increased intensity of land usage, improved husbandry, greater protection against diseases and pests and the vast development in quality and quantity of technical equipment at the farmers disposal have resulted in a rise of four-fifths in the quantum of net output per agricultural worker. Table 1 suggests the extent to which this increase may be attributed to the growing use of machinery.

TABLE 1.—*Some Types of Agricultural Machinery in Use in England and Wales*

	1942 ('000)	1959 ('000)
Tractors	101·5	415·8
Corn drills	84·0	78·8
Combined corn and fertilisers drills	7·2	64·4
Combined harvester and threshers	0·9	48·6
Hay and straw balers	2·2	6·1
Pick up balers	—	61·7
Fruit sprayers	6·0(*a*)	57·3

(*a*) Approximate

The second aspect of the increase in real level of food consumption is the expansion of the food processing industry and the development of entirely new lines. The development in certain areas of food processing may be gathered from Table 2.

TABLE 2. *Production of Certain Processed Foods in the United Kingdom Pre-War and 1959. '000 tons*

	Pre-war	1959
Canned fish	8	12
Canned meat	30	51
Canned fruit	26	107
Canned vegetables	160	563
Chocolate and sugar confectionery	499	620
Milk powder	21	48
Margarine	208	358
Compound cooking fat	116	133
Biscuits	300	515

Apart from these striking figures the vast expansion of the soft drink and ice cream industries has almost brought their products within the range of conventional necessities.

Entirely new products have made their appearance. Thus 43 thousand tons of white fish and 43 thousand tons of fruit and vegetables were quick frozen in the United Kingdom in 1959 and the range of other quick frozen foods is now very extensive. Dehydrated foods are appearing in various forms. Broiler chickens are newcomers to the table but they already number something like one hundred million a year.

Marketing of perishable foods is gradually being streamlined; commodity markets and marketing methods which have evolved over centuries are being reviewed by traders and trade bodies, and some reorganisation to take account of the large conurbations and of the internal combustion engine is to be expected. The present congestion in the markets of many of our cities is so great that the waste in time and material may well increase faster than any potential increase in the volume of trade in the market. Some market sites may be replanned comprehensively, and it may be found necessary to move some markets out of city centres, but these approaches can only be long term projects. The immediate hope for relief is in more efficient handling, improved design of containers, palletisation and the fork lift truck, as well as improved grading, recognised quality standards and quality control which could lead to purchase by sample and the elimination of substandard produce.

STREAMLINED MARKETING

Elaborate, attractive and sometimes expensive new methods of packaging have been used to attract the consumer, who has more purchasing power than ever before. This development has been encouraged by improved standards of hygiene, by the development of television as a new advertising medium and by the intensification of competition between one food and another.

New techniques of retail sales, such as self-service and the super-market, have combined time and motion study, methods of mechanised handling, the use of the newest materials and gadgets, and studies in applied psychology. Retail vending machines provide for the impulse purchaser and for those who would otherwise have gone without for want of a source of supply.

Has this extensive development in the variety and quality of food and in the preparation and presentation of products to interest the consumer worn itself out? If we have attained such a high average calorie level is there scope for a continued real increase in expenditure on food?

The average calorie level represented by food supplies is perhaps 25 per cent higher than average physiological requirements. Since there is no evidence that the population as a whole is steadily increasing in weight, it would appear that about one-fifth of the calorie content of food entering the distribution chain at the present time is not actually eaten. There is inevitable wastage in distribution due to deterioration, to trimming and to local variations in supply and demand. Further loss in the home arises from more trimming, from cooking loss and plate wastage, and some food is fed to domestic animals. Even in the years of food shortage after the war when the population was losing weight the total of these margins was probably of the order of 12 to 15 per cent, but any excess over this level probably indicates some difficulty in persuading purchasers to take some relatively unattractive portions and second-grade produce. Doubtless there is also some increase in wastage in the home with more abundant supplies.

Analyses give support to the suggestion that although there is no call for a greater bulk of food, there is still room for increased supplies of some foods. The amount of animal protein in the diet is some indication of its attractiveness, and the level in this country is still about 25 per cent lower than in the United States.

A further indication from the analysis of demand is that the real scope for extension in the market for food is in terms of improved quality and service, ranging from the primary producer to the services which retailers can offer.

During the last three years the calorie level of the national diet has varied in the United Kingdom by less than ± 1 per cent. Animal protein has increased by about 2 per cent, with a corresponding fall in vegetable protein. Fat from all sources has risen by only about 1 per cent. Consumption of poultry, fresh fruit and sugar have increased markedly, but consumption of grain products and potatoes have both fallen by something like 5 per cent. Other changes in basic foodstuffs have been slight. Broadly, changes in demand for the basic foods are likely to continue to be compensating. The consumption of potatoes and bread has long been declining, but the rate of decline appears to depend on the expansion of supplies of animal products of the grades and types which the consumer wants without increases in relative prices. It is impossible to say how far the change will go in the United Kingdom.

There is, however, no narrow limit to the amount of service which can be added to food before it reaches the consumer. Between 1956 and 1959 United Kingdom consumers' purchases of food per head valued at constant prices rose by about 3 per cent, equivalent to a total of some £50 million a year at today's prices. Much of this clearly represents improvement in quality or greater processing and service. The precise balance of consumption of many basic foods will depend on the extent to which processed products improve in appearance, palatability and price. As processed foods become increasingly and uniformly attractive, the consumer's choice may be more frequently determined by price.

QUALITY CONTROL

About 1½ million people (7 per cent of the working population) are at present employed in the processing and distribution of food. It is becoming difficult in some places to recruit workers to maintain this level at present relative wage rates. Unless prices or labour shortage are to hinder the steady development of the food trades, technical development in factory, market and retail shop must, therefore, be directed towards the greater productivity of labour as well as to greater direct satisfaction for the consumer.

Retailers have already entered on the age of labour economy. The first move is in the study of layout we associate with self-service. Fuller automation may be in prospect. Limited pilot experiments incorporating electronic control of wholesale and retail sales are already taking place in the United States. Choice of goods by the purchaser from samples and dummy packs followed by mechanical assembly and billing of the selected articles concentrates a minimum labour force on replenishing supplies in a bulk storeroom. This, of course, calls for the most stringent quality control. An electronic computer is already being used by a large firm of caterers to control daily despatches to branches, to instruct supply departments, sort loadings, and maintain the necessary accounts.

The prospect then, seems to be for an intensification of the struggle at all levels from farmer to final distributor for quality and palatability, for increased productivity, particularly of labour, for better grading and merchandising in commodity markets, for attractive packaging and display, and generally for more service to the consumer. The measure of success of such efforts will be the extent to which food producers and distributors are able to obtain their share of the increasing real income at the disposal of consumers.

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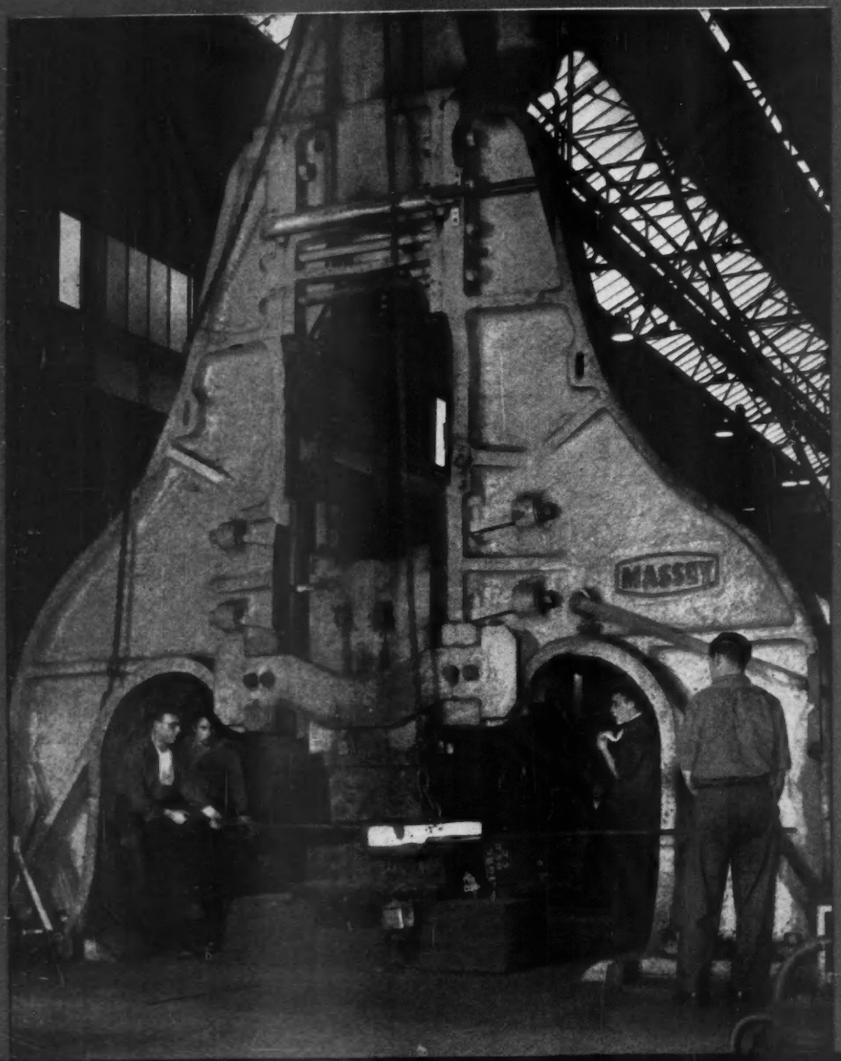
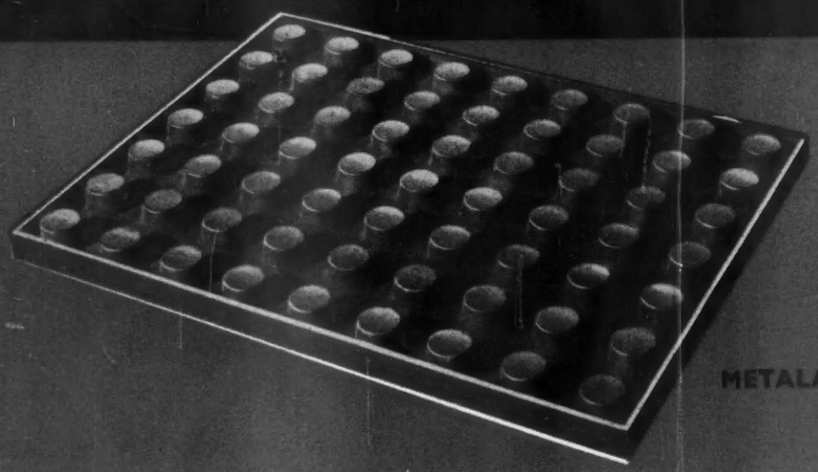


GROUND VIBRATION reduced 90% or more

Metalastik Carpet mountings under a well-designed inertia block permit ground vibration from forging hammers and heavy machinery to be reduced to almost any degree. They are equally suitable for protecting precision machines such as roll-grinders and jig-borers from transmitted vibration. Free from corrosion or deterioration they are easy to install and actually simplify the casting of inertia blocks in situ.

Carpet mountings are fitted under the 4-ton Massey hammer in the photograph, reproduced by courtesy of Jessop-Saville Ltd., Sheffield. Contractors for the foundation: Wellerman Bros. Ltd., Sheffield.

METALASTIK



CARPET MOUNTINGS

METALASTIK LTD., LEICESTER

M 288

Human Element

Engineer Ambassador from Norway

A young Norwegian engineer, who served as a parachutist with the Allied forces during the war, is in Britain with the role of engineer-diplomat and an assignment which could be called that of getting the best out of the European Free Trade Area agreement for the engineering industries of Norway and the United Kingdom.

He is Per Ihlen, who ten years ago took his mechanical engineering degree at Heriot-Watt College, Edinburgh, and who for five years was the engineer to the secretariat of the Norwegian KMT group.

The purpose of Ihlen's job is simple. Working from the Norwegian Export Council (at 20 Pall Mall, London, SW) he is travelling the length and breadth of British industry looking for firms who are interested in seizing the advantages of the Free Trade Area agreement. The Norwegians, through Per Ihlen, are interested in having certain of their products manufactured in the United Kingdom under licence. They have highly skilled workmen and capacity available to undertake work for British firms and they have a strong desire to buy from this country, with whom their association is long and strengthened by recent history.

Delivery Times

The fact that delivery dates have often been a hopeless liability to products from British firms when they have been in competition with those of other European makers is the most commonly advanced reason for the substantial Norwegian purchasing of, for instance, West German machine tools. Price is not thought to be a decisive factor in this particular case.

The most obvious decline in Anglo-Norwegian trade has been in ship-building, where the British yards once held a commanding position. If this had been lost because of delivery date troubles alone it might be a more easily recoverable situation than it in fact is. Much of the Norwegian preference for the shipyards of other nations (notably Germany and the Netherlands, Sweden was always high on the list) is thought to rest on the disruptive effect demarcation and other disputes have had on building schedules. For this reason a yard standing empty is no guarantee that a vessel will be built on time.

As a nation with high and rising standards of living Norway is an important partner to Britain in the Outer Seven group. Between 1946 and 1957 the Norwegians were spending 6 per cent of their aggregate national income on capital investment in the manufacturing and mining industries, a sure index of the continued growth of the country, as a producer and as a market.

ENGINEERING's representative asked Mr. Ihlen why he thought British delivery dates were so much longer than those of West German producers.

An important reason, he suggested, was that the German manufacturer was much more flexible. A United Kingdom firm faced with the lack of a part needed in an assembly might very well inform the waiting customer of what was happening, put back the delivery date and complete the job when the part became available.

It would be much more typical of the German manufacturer, in Mr. Ihlen's experience, to have inquiries made around Germany, and even in France, to find a sub-contractor who would make the part and enable the promised date to be kept.

Not every sub-contracting works in Britain is going at such a pace that there is neither spare man nor machine: some room to emulate the more flexible German competitor would seem to exist.

Blind Farmer's Fight for Independence

A blind ex-Serviceman, formerly an engineer, who is struggling to make a life for himself independent of official bodies, has recently been given some valuable local help after a period of discouragement.

The former engineer is Mr. Albert Newman, who moved from London last year to 87 acre Glantegfan Farm, near Cardigan. Mr. Newman, who is trying to bring the farm back to fruitful use, has been given a tractor by a Swansea firm, C. E. M. Day, who had heard of his difficulties. A farmer with a herd in the same district has given a calf.

Ploughing for Mr. Newman has to be by radio signals. A set fixed to the tractor sends out signals which bounce back to his earphones from aerials set at the edge of the field.

Once the farm has become fully productive again Mr. Newman hopes to make profits which will enable him to set up a fund for the assistance of blind people who wish to make their way independently of the existing organisations. The idea is that the fund should make interest free loans to those setting out on business ventures—the money to be repaid when success had been achieved.

An Independent Study of the Trade Unions

A great volume of comment and criticism of the trade unions appears day by day, in the Press, in books and on the air. That part of the great stream of opinion that is objective is so exceptional as to be outstanding.

Now an independent research organisation, Political and Economic Planning, is to undertake a three-year study of trade unions. Some idea of the terms of reference which PEP has set itself is suggested by the title, Trade Unions in a Changing Society, which it has given to the work.

The inquiry has been made possible by a £19,900 grant from the Leverhulme Trust Fund. The fund's trustees have in recent years provided financial support for a number of inquiries into labour relations.

The PEP study will include the functions being undertaken by the trade unions, the development of their organisations and the unions' position in relation to the law.

While essentially an inquiry into British trade unions, relevant union experience from other countries will be considered.

Itinerant Oases for the Desert Pioneer

Always seeking fresh fields to conquer, the engineer is currently turning his attention to the frozen wastes and deserts of the earth. The modern pioneer, prospecting for oil or minerals in the Sahara, travels by air, lives in an air-conditioned caravan and feeds on frozen delicacies. But he may nevertheless be glad to know that, even if his supplies were suddenly cut off through misadventure, the desert would support him. Like Flight Lieutenant Billingham, he may quell his appetite and slake his thirst with snails.

For four days Flight Lieutenant John Billingham of the Royal Air Force Institution of Aviation Medicine at Farnborough lived on the haemolymph or blood of snails found in the Northern Libyan desert. On each of the four days he spent six hours in a hot chamber held at 118° F to simulate desert conditions. During this time he consumed four pints of the fluid obtained from 1,100 snails which have now been identified as belonging to the *Eremina Ehrenbergi* Roth species. At the end of the test he had lost only 11 lb.

The fluid has a slight salt flavour and contains a small quantity of protein. It is obtained by crushing the snail, and examination has shown that it includes no harmful bacteria.

The experiment has proved that it is possible for members of an air crew in distress—or stranded pioneers—to live on this fluid, but the geographical distribution of the snails is variable and few snails are found to exist south of the "scrub line."

We're All Right Jack

Nothing brings personal drama to factory life so easily, or so it appears from the morning papers, than a strike, and preferably a strike over strong language by a foreman or for some other apparently irresponsible reason.

The facts of industrial life are in reality very different. The Trades Union Congress has now published its report on trade disputes and on shop stewards. The report was promised at last year's annual conference and appears in good time for discussion and assimilation before this year's meeting.

It shows that of the 147 unions who sent replies to the TUC questionnaire, 85 had no strikes at all in the past four years. These unions had a membership of 1,268,000 out of the total 7,510,000 membership of all the unions that sent.

There is some evidence about the report of complacency. It points out that, leaving the bus and printing strikes aside as major struggles over policy, neither in 1959 or 1958 were as many working days lost as in the period 1940 to 1950. Remembering this, and that other countries also have strikes, may help to keep a sense of proportion, says the TUC's report.

But is this accurate? The report says that the heaviest time losses were in shipbuilding—less than two days in the year—and in motor car production —less than one day.

The British shipyard worker is facing unemployment if a major change in the present slack state of new orders is not brought about. There are countries in the world where Britain's place at the head of the overseas builders of the merchant marine has been taken over by others. And the reason is not given as one of price and certainly not because of the quality of the ships.

Demarcation Damage

The given reason is much more likely to be because in the past delivery dates for ships have been at the mercy of demarcation and other strikes. Once a shipowner has got it into his head that in a certain yard there is liable to be a delay of months over his ship because no one can agree who is to drill holes in new material, his new orders may go to the yards of another country for good.

But a demarcation dispute is not silly to the men concerned. For them it may be the difference between overtime and the basic rate, even between work or job-hunting.

Which is why, when a demarcation dispute has dragged itself on for weeks, the reputation of British shipbuilding suffering and the men without wages, the question most needing to be answered is whether the union leadership is doing its job.

And on the subject of improving the quality of trade union leadership the TUC report has curiously little to say. True enough the trade unions do not ask to be immune from criticism. It is one of the odder facts of the political scene that, however hostile the individual Labour Correspondent may be either to trade unions or to the Labour Party, he will have no difficulty in picking up from trade union leaders all the facts he wants on internal dissensions and rivalries.

The report warns unions to keep a closer eye on shop stewards and if necessary to be ready to withdraw the credentials of a shop steward who acts in any way contrary to union policy. It would be interesting to see what would happen in some factories if the remote union head office tried such an experiment. Production might or might not stop. More than probably it would.

Little Contact

But the chances of the local paid official getting a hearing at the next mass meeting called to discuss what the aggrieved parties would surely be calling "dictatorship" would not be good. Up to a point the power of shop stewards in an industry rises in direct proportion to the lack of contact that the union's officials have with their members.

For the TUC to be solemnly condemning attempts to run a national movement of shop stewards is rather like the General Staff of an Army putting out a communiqué saying that the corporals are not in charge. When the official leadership is reduced to circumscribing the activities of a section of its most active members, it is a fair indication that the present leadership of the unions is not achieving the fullest contribution to the country's industrial and general well-being.

Protein from Leaves by Bulk Extraction

Edible protein may be extracted from leaves by first bruising the plant cells in a pulper and then applying pressure. A process employing a hammer mill and a cam-operated press has yielded 75 per cent of leaf protein content.

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ADVANTAGES that may be expected from the development of practical methods for separating protein on a large scale from various types of leaf have been discussed elsewhere by Pirie[1,2]. Methods have been described by Morrison and Pirie[3,4] for preserving and purifying the protein and for incorporating it into foods in a manner that most people find acceptable. Duckworth, Hepburn[5] and Woodham[6] have published experiments on pigs, rats and chickens showing that the protein is not only palatable but nutritionally valuable. This article deals only with the process of extracting protein from leaves and with the reasons governing the selection of certain types of machine for the purpose.

Ideally, juice would be separated from fibre in one operation. The ideal is readily achieved in the laboratory and many people have claimed success on a large scale with 3-roll sugar cane rolls or screw expellers modified in various ways. An extensive series of tests on units such as these in 1940-42 resulted in the conclusion that for continuous large-scale operation they would not be satisfactory. Obviously, improvements in design may sometime invalidate this conclusion and we are working on the design of a batch-type machine to make juice from 100 to 300 lb lots of leaf in one operation. But at present we regard pulping the leaf and pressing out the juice from the pulp as essentially different operations that may conveniently be performed in different machines.

BRUISING

Significant amounts of protein cannot be pressed out from undamaged leaf cells. But it is not necessary to cut open every cell to obtain satisfactory liberation. Thorough bruising is sufficient; furthermore very fine grinding is extravagant and increases the problems of juice separation at a later stage. This bruising is as effectively done by rubbing the leaves against each other as by rubbing them against the surfaces of the machine, but the soggy and dough-like consistency of a mass of properly pulped leaf makes it imperative to keep the mixture open; hence slow moving machinery in which bars are forced through a compacted mass are unpromising. Three other important factors influencing pulper design may be mentioned. Power consumption must be kept low, not only for economy but also because much of the protein coagulates on the fibre if the temperature of the pulp rises above 50° C. This limits the power consumption to 50 h.p. for a ton per hour grinding rate; in practice we can run at a half or one-third of that power consumption. The machine must be able to cope with occasional stones, sticks and bits of metal for these, especially the first, will unavoidably be present in an agricultural product collected on a large scale. Finally the machine must not clog either from overloading or from the accumulation of the more resistant pieces of fibre in the charge. The last factor has the greatest effect on design.

The trials made in 1940-42 showed that high-speed fixed-hammer or swing-hammer mills meet all these requirements except the last. A dozen different makes were tested and in each the screens or bars that keep the charge in the working volume until pulping is satisfactory blinded over with fibre after a few minutes running. This difficulty was easily overcome by pulping in the presence of so much water that the product became mobile enough to flow out of the machine. But water supplies are not always ample in places where leaf protein might be made and it is inconvenient to handle very large volumes of dilute leaf extract. Apparently this is the method that has recently been adopted by British Glues and Chemicals Limited. (ENGNG. 1959.[7]) Our alternative solution was to design a pulper that cannot clog but discharges whatever is put into it whether pulping is complete or not. The setting of such a machine must be controllable so that in spite of variations in texture the crop emerges properly pulped.

In 1948 a Christy and Norris "Coir Sifter" was installed after slight modification and, in the light of experience, it was extensively modified. This machine has already been described briefly by Pirie[2] and illustrated by Raymond and Tilley.[8] An improved machine was made in 1953 and last year Christy and Norris supplied another; its performance is good enough to justify more detailed description.

BUILT-IN FLEXIBILITY

Twenty-eight beater arms are carried on a horizontal hub inside a steel drum 3 ft long and 3 ft in diameter. One third of the drum casing is hinged so as to allow the inside to be cleaned and the disposition of the beaters to be changed. Two men can easily lift the swinging section and fasten it as shown in Fig. 1. The first pair of beaters is bolted to the hub so that there is only 0·5 in clearance from the end of the drum, these have a 30° set so as to suck the charge into the pulper. The other beaters are carried in sockets in the hub. Experience shows that the gap between the tracks of the tips of adjacent beaters must not exceed 1·5 in or a wall of pulp will build up in the gap and then collapse and cause uneven running. Experience also shows that the beater ends should not be more than $\frac{3}{8}$ in thick in a direction parallel to the axis, or lumps of fibre remain wedged between the beater ends and the case of the drum and cause heavy running To satisfy these requirements, while still using a standard design of hub, the beater ends are U shaped thus doubling their effective number. Some of these U's have their faces parallel to the direction of motion and so simply beat the charge without moving it forwards, one face of the others is twisted by 10° about a radius of the pulper and so move the charge along. By varying the ratio of these two types of beater ends, which are interchangeable in all positions on the hub after the first, the time of passage through the pulper and so the amount of work done on the charge can be varied. These three types of beater are shown in Fig. 2 in position on the hub; spares are also shown lying on the ground under the pulper. Further control over the amount of work done on the charge is given by eight pairs of $\frac{5}{8}$ in diameter pins that can be screwed through the casing of the drum into the gaps between the beaters. One set can be seen at the bottom of the casing in Fig. 2, the other set is diametrically opposite.

Material to be pulped is fed axially through an opening 14 in wide and 6 in high by a belt running at 6 ft per sec and passing round a 2 in diameter roller set as near to the end of the pulper as possible. Pulp emerges tangentially at the other end through an opening $9\frac{1}{2}$ in wide. The depth of this opening (measured along the circumference of the pulper casing) and the direction of the stream are controlled by a set of steel slats $\frac{1}{4}$ in thick and $1\frac{1}{2}$ in wide bolted to studs on the outside of the pulper casing. An opening $7\frac{1}{2}$ in deep is suitable for most materials.

Leaves vary greatly in texture: sugar beet and pea haulm pulp very easily, mature grasses and cereals are harsh. For the former the pulper is fitted with 8 or 10 pairs of the propelling type of beater and rung at only 424 r.p.m. (tip speed 3,950 ft per min), for the latter the number of propelling beaters is reduced to two or three pairs, the speed increased to the maximum 955 r.p.m. (tip speed 8,870 ft per min) and the pins are screwed through the casing so as to protrude $\frac{1}{2}$ in into the pulper and break up the flow of material. If the texture of the pulp is unsatisfactory, the pins can be readjusted while the pulper is running; a change of beaters, or of driving pulleys, takes 10 minutes. The pulper is driven by a 25 h.p. 3-phase electric motor and the pulp output varies with the texture of the crop from 2 to 3 tons per hour to $\frac{1}{2}$ ton per hour. In our experience with British crops, no leaf from which it is possible to extract by this technique useful amounts of protein will require more power for pulping than this, but some tropical crops, sugar cane tops for example, may need a larger motor.

Leaves also vary in moistness. When the water content exceeds 85 per cent, as with pea haulm, very early cuts of cereals, or clover, nothing is gained by adding water during the initial pulping; it is preferable to pass the fibre, after pressing, back through the pulper and make a second extract with added water. With more mature leaves water should be added during pulping so as to get a pulp containing about 85 per cent water. Fig. 1 shows the

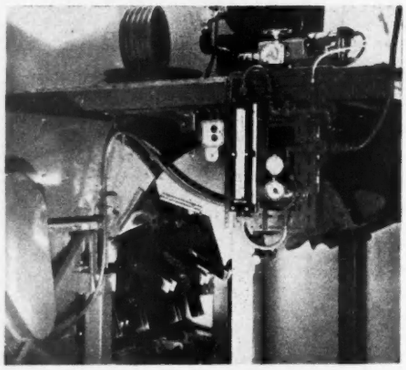


Fig. 1 Hammer-mill pulper, designed for accessibility. The drum is shown open. Control equipment is used for adding water and alkali.

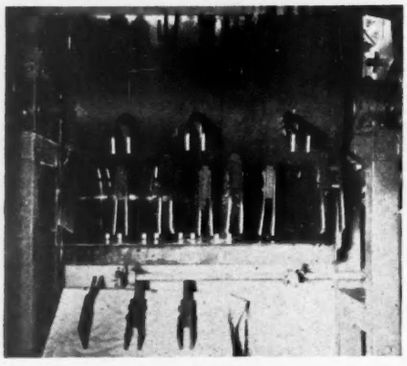


Fig. 2 Work done on the charge is regulated by varying the number and type of hammers and studs. Hammer types are shown in foreground; a row of studs is installed in the drum.

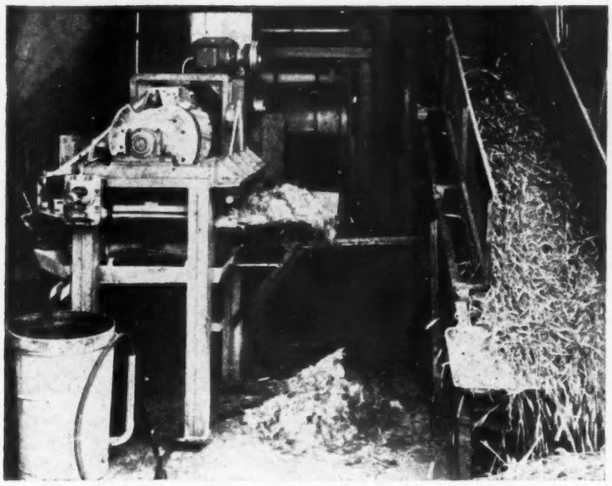


Fig. 3 The crop is carried up the elevator on the extreme right, falls on to a conveyor and passes into the horizontal drum of the pulper. Pulp flies out from the left-hand end of the pulper into the cowl in the centre of the illustration and falls on to the perforated circular table of the press.

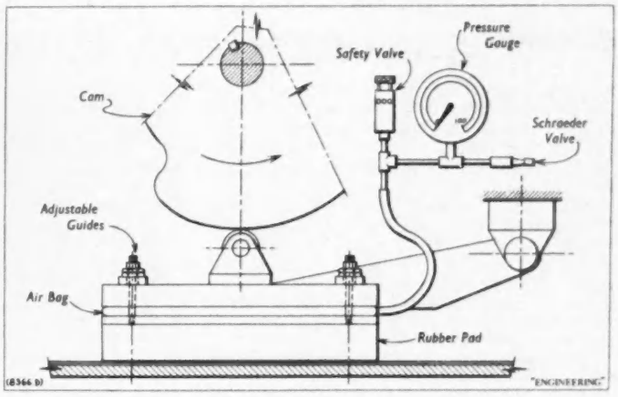


Fig. 4 (above) Lay-out of cam-operated press. The pressure exerted depends on the amount of fibre under the platen.

water inlet at the bottom of the stationary part of the pulper end and, in the top right hand corner, the cocks, flow-meter and integrating meter used to control the amount added. In general extracts from leaves that are suitable for protein extraction are neutral and little or nothing is gained by adding alkali during pulping. Mature leaves tend to be more acid while some species are always acid, but protein can often be more completely separated into an alkaline environment from fibre that has been extracted once already (Lugg,[9] Crook[10]). We therefore have a small pump with variable delivery to feed alkali into the water when necessary.

CAM-OPERATED PRESS

Many different types of press have been tried for removing the juice from the pulped leaf. The reasons for the unsatisfactory performance of screw expellers and roller systems have already been stated briefly by Pirie.[11] Two machines in which pressure is applied intermittently and the charge is moved forwards between applications of pressure have been made and tested. The first has already been described and illustrated.[10] The press we now use has an annular table of $\frac{1}{4}$ in thick steel punched with $\frac{1}{8}$ in holes, its inside and outside diameters are 3 ft and 6 ft respectively. The table is mounted horizontally on rollers and is located by roller bearings on a ring 1 in square in section mounted on its inner edge. The outer edge is stiffened with an angle iron hoop. Fig. 3 shows the hinged platen under which pulp is carried by this table and it also shows the cams that force the platen down. When pressure is released another cam, not visible in Fig. 3, lifts the platen and moves the table forward (from left to right in Fig. 3) by means of a bell-crank and lever engaging a set of pins spaced 20° apart around the inner ring.

The platen, cams, and cam-followers are set so that little pressure is exerted when there is no pulp on the table. The amount of pressure exerted therefore increases with the thickness of the compressed layer of fibre. This is an advantage because juice runs out more easily and rapidly from thin layers. Elasticity is given by covering the platen with a 2 in thick layer of sponge rubber encased in rubber sheet, and an indication of the pressure actually exerted is given by a heavy rubberised fabric air bag between the plate carrying the sponge rubber and the hinged platen that is forced down by the cams. A short narrow tube connects the air bag to a pressure gauge, safety valve and nipple for a tyre pump. This arrangement is shown diagrammatically in Fig. 4. For normal running, the air bag is inflated to 20 lb per sq. in pressure and adjusted to $\frac{1}{2}$ in thickness, and the safety valve is set at 60 lb per sq. in. The usual layer of pulp averages 2 in in depth before pressing and less than $\frac{1}{4}$ in after pressing. The usual maximum pressure is 40 lb on the gauge, which, because the air bag has only half the area of the platen, represents 20 lb per sq. in pressure on the pulp. Higher pressures do not produce enough extra juice to compensate for the necessary increase in frame and cam-shaft strength.

A grid of 1 in by $\frac{1}{4}$ in steel bars set on edge is mounted on the frame underneath the annulus where it is subjected to pressure. The rollers on which the annulus moves have therefore only to bear the weight of the annulus and of the pulp on it; the actual pressure is carried by the grid. A tray below this grid collects the juice and leads it to a fine gauze strainer that catches the small quantity of fibre that passes through the perforations in the annulus.

Experience in the laboratory and with early forms of press shows that, although juice will not run away from the fibre in a second (which is the main reason for the failure of roller arrangements), 5 to 7 seconds pressing allows 90 per cent to get away. The cam shaft is therefore driven at 7·5 r.p.m. by a reduction gear and 2 h.p. motor, but other pressure durations can be arranged by using different V-belt combinations between motor and reduction gear. The profile of the cam is shown in Fig. 3. Rotating counter-clockwise, pressure builds up for 75°, is held for 240°, released in 15°, and indexing occurs over 30°. Pressure release must be gentle for the first 0·5 in or the energy stored in the air bag and sponge rubber gives a damaging reverse twist to the coupling between the cam shaft and gearbox. While keeping the same principle of annulus and hinged platen, this cam drive could obviously be replaced by a double acting hydraulic cylinder and timer. We have used both arrangements on presses and find advantages and disadvantages in each.

Ideally, with even loading of the pulp, this press should handle about 1·5 tons per hour with an 8 second cycle, but in practice it will handle only one-third of that amount, mainly because of unevenness in the feed. Some improvement in throughput can be obtained by mounting a pre-presser in front of the platen. The pre-presser, lifted by the platen, exerts only 2 to 3 lb per sq. in pressure and brings out only 10 to 15 per cent of the juice, but it arranges the charge so that the high pressure is exerted more effectively. Even with this modification the press cannot keep pace with the pulper and another press of similar design but with a larger annulus is now being made.

Fig. 3 shows the general layout of the two units when in use. Pulp flies from the pulper in a steady stream, at about 40° to the horizontal, under a cowl. The aim is to spread the pulp over the perforated table sufficiently evenly to compensate for the table's intermittent movement, so that the layer does not have a series of ridges on it. Unless the water content exceeds 85 per cent, no juice drips through till the pre-pressing stage is reached. After the main pressing the fibre feels dry to the touch but still contains 70 to 75 per cent water, does not adhere to the annulus, and is easily scraped off by the diagonal board shown in Fig. 3. It is generally worthwhile passing the fibre, this time with water, through the pulper again because the first extraction seldom brings out more than 50 per cent of the protein while the second will bring out a further 25 per cent. If the pulper has been properly set, a third extraction brings out too little protein to justify the power consumed.

This unit has now been in use for two years and has handled several hundred tons of material. Various aspects, for example the feed mechanism to the pulper, the profile of the cams, and the mechanism moving the annulus, are still being improved. We think, however, that the principles are sound and that they may be of use in other processes besides extracting leaf protein.

REFERENCES

[1] N. W. Pirie. "The Direct Use of Leaf Protein in Human Nutrition." *Chemistry and Industry*, vol. 61, p. 45, 1942.

[2] N. W. Pirie. "Large Scale Production of Edible Protein from Fresh Leaves." *Rep. Rothamsted Experimental Station*, 173, 1952.

[3] J. E. Morrison and N. W. Pirie. "The Presentation of Leaf Protein on the Table." *Nutrition*, vol. 14, p. 7, 1960.

[4] J. E. Morrison and N. W. Pirie. "The Large Scale Production of Protein from Leaf Extracts." *Journal of the Science of Food and Agriculture* (in press), 1960.

[5] J. Duckworth, W. R. Hepburn and A. A. Woodham. "Leaf Protein Concentrates. Part 2. The Value of a Commercially dried Product for Newly-weaned Pigs." *Journal of the Science of Food and Agriculture* (in press), 1960.

[6] J. Duckworth and A. A. Woodham. "Leaf Protein concentrates. Part I. Effect of Source of Raw Material and Method of Drying on Protein Value for Chicks and Rats." *Journal of the Science of Food and Agriculture* (in press), 1960.

[7] "Protein Production by the Impulse Process," *Engineering*, 9 Oct. 1959, p. 307.

[8] W. F. Raymond and J. M. A. Tilley. "The Extraction of Protein Concentrates from Leaves," *Colonial Plant and Animal Products*, vol. 6, p. 3, 1957.

[9] J. W. H. Lugg. "The Representativeness of Extracted Samples and the Efficiency of Extraction of Protein from the Fresh Leaves of Plants; and some Partial Analyses of the whole Proteins of Leaves." *Biochemical Journal*, vol. 33, p. 110, 1939.

[10] E. M. Crook, "The Extraction of Nitrogenous Materials from Green Leaves," *Biochemical Journal*, vol. 40, p. 197, 1946.

[11] N. W. Pirie. "The Large-scale Separation of Fluids from Fibrous Pulps." *J. Biochem. Microbiol. Tech. Engng.*, vol. 1, p. 13, 1959.

Clearing Reeds from Water Courses

Keeping watercourses, dykes and farm drains free from reeds that threaten to prevent the flow of water is a perennial and costly job for river and drainage boards, and for the farmers also. To date it has not proved practicable to mechanise the work.

Hand cutting of reeds, using a scythe, is the traditional method, but it is slow and costly, and anyway suitable labour for such an operation is fast disappearing. The cost of hand cutting reeds will be between 10*s* and £1 a chain for a single cut and the work will probably require doing twice a year; it is also likely that cutting stimulates growth.

The possibilities of chemical attack on the reeds has been recognised for some time but such an approach has been hindered partly by a lack of suitable equipment and also because there was a deep seated fear that herbicides must be toxic to fish and waterfowls. New chemicals are now available, however, that while being destructive to the vegetable growth are harmless to animal life in the concentrations used, so that reeds growing along the banks of reservoirs or in drainage ditches can be destroyed without risk to food supplies.

Such a chemical, able to destroy emergent weeds but harmless to fowls and fish, is Dowpon, which is made and marketed by Dow Agrochemicals Limited, whose headquarters address is 48 Charles Street, London, W1. It is capable of controlling couch, creeping bent, onion couch, the common reed, reed mace and many other annual grasses that are weeds. It will also cope with bracken. The active ingredient in Dowpon is dalapon or dichloropropionic acid; in its commercial form dalapon is used as a sodium salt. It is a white to light tan powder containing 85 per cent by weight of the sodium salt to which a wetting agent has been added. The agent is necessary to increase the effectiveness of the herbicide which it does by accelerating absorption of the chemical through the leaves.

Dowpon is readily soluble in water, producing a slightly acid solution, and it is non-volatile. It is slightly hygroscopic and must be stored in moisture proof containers. Maximum effect is obtained by applying the chemical to young foliage in full growth; it is absorbed in about three days and translocated down to the roots where it inhibits the development of the plant by interfering with the formation of the pantothenic acid (which is an essential part of the co-enzyme A)

When a lethal dose is applied, the buds on the underground stems of the grasses are killed and death of the grass occurs. Successful action by the herbicide is shown by a yellowing of the foliage, starting at the tips, followed by collapse of the stalks. After about three weeks the weeds are found to have died back, but probably the quickest way of disposing of the dead reeds is to fire them while they still stand—if necessary giving them a light spray with paraffin to get them to burn easily.

A variety of equipment is available for applying soluble herbicides. Most mobile is the knapsack container used with a lightweight hand sprayer; men can work singly but they are limited by the capacity of the portable container and the need to replenish it. A greater working capacity is obtained by putting a tank on a tractor or some other vehicle; in this way tank capacities up to 300 gallons are practicable and high pressure spraying, at pressures up to 200 lb per sq. in, are possible. With such vehicles the most suitable equipment has been found to be a three-nozzle lance on a considerable length of hose, which allows a 6 ft width of reed growth to be tackled. For this method of working teams of three are required—the tractor driver, a follower who can manhandle the hose, and the man with the spray. The advantages of pressure spraying are the greater penetration obtained in thick growth and overcoming the dispersal of the spray by the wind.

A ditch badly overgrown with reeds being treated from a knapsack sprayer, using a three-nozzle hand lance.

A typical dosage for an overgrown drain would be 1 lb of Dowpon in two gallons of water sprayed along a 7 chain length of 9 ft wide ditch, costing about 1*s* 3*d* per chain. The growth of grass on the banks, too, can be kept down to minimise cutting, by a light treatment at the rate of 2½ to 4 lb of Dowpon to the acre.

If the ditch contains, in addition to reeds, broadleaved weeds such as assorted aquatic weeds, a heavy dose of Dowpon (8 oz per chain) can be supplemented by a new Dow Agrochemicals' product, Kuron S. This treatment was recently used in badly overgrown Sam's Cut belonging to the Great Ouse River Board. This is an 11 ft wide ditch, but a 10 chain length was adequately sprayed in half an hour, working with a spray unit mounted on a Land Rover. It is believed that effective control of the weeds has been obtained for at least three years.

More Water for the Farm

During the last ten years there has been a remarkable increase in the demand for water for agriculture. First came the dairy industry with the drive for TT herds and increased milk production: with the greater attention given to hygiene, the daily demand for a cow in milk is now about 30 gallons a day, and there is a proportionate demand for other stock. Compared with the occasional trough to supplement the nearby stream or local pond, new practices have meant the construction of mains, the replacement of those of 2 in or less, and the provision of pumping equipment at strategic points. In addition, there is a heavy demand on the dairy farm for water for cooling the milk, a demand that tends to give rise to daily peak loads on the water supplier as farmers in the area complete milking. Some relief from this load of cooling water is to be expected as farmers instal mechanical refrigeration plant. Hitherto, some easement of the peak load on the mains has been obtained by farmers putting in large storage tanks that are filled during off-peak hours.

But even heavier than the dairy demand has been the rediscovery of crop irrigation and the recognition that, in Britain at least, there is a frequent and considerable water deficiency. It is now reckoned that the summer rainfall in south-east England is about 5 in short of what is required. In that part of the country, irrigation is actively needed for eight out of every ten years while, for much more of the country, rainfall should be supplemented during the summer months of June, July and August for some five years in every ten. Probably the most important crop that can benefit from irrigation in Britain is the grass crop. Grain crops show a varied response but in general all other vegetable and fruit crops are improved by irrigation, though the timing of the application is critical.

The magnitude of the deficiency varies both with the area and with the crop. For a market garden located on the Hertfordshire-Bedfordshire boundary some irrigation is required four years out of five and the need in an average year is between 2½ and 3 in. What this means to the water supply companies can be best appreciated, not in so many inches of rain, but as 22,600 gallons per acre for every inch of the deficiency. That is to say, a 12 acre holding could call for one million gallons during the three summer months. The potential of this demand is magnified because it occurs when other water demands are at their peak and when every stream is at its lowest. Few farmers could instal storage reservoirs sufficient to meet the sort of demand envisaged.

The water, however, is expected to do more than irrigate the ground and the crops. It is the simplest and most effective way of distributing and regulating the application of fertilisers, including liquid manure. To this end the equipment on the farm has got to be able to introduce measured quantities of the fertiliser into the mains supply, enabling the concentration to be reduced to a usable and uniform figure. Where the indigenous farm manure is used—cattle produce 15 tons per head and a fattening pig 35 cwt a year—suitable shredding machines and pumps are required, though half of the nutrient value of the manure is contained in the liquid part.

The most commonly observed way of distributing the water, and the fertilisers, is by spraying and it is this method that has perhaps given rise to the greatest part of the increase in the farmers' water demands. But damage can occur to the soil if the water is applied in too large a drop-size, and the damage will be severe if it reaches 4 mm. Early sprinkler equipment in this country consisted of galvanised piping, between 1 and 1½ in in diameter, drilled with small holes at 2 ft centres. The first refinement to this equipment was the substitution of small brass jets which eliminated blockages due to corrosion. These pipes were rotated through 180° by water driven oscillators. Such equipment operates with a water pressure of between 40 and 60 lb per sq. in.

By far the most popular equipment for overhead irrigation is a sprinkler that works at a pressure of about 35 lb per sq. in. It has two nozzles: a long range high pressure nozzle used to spray the outer part of a circle at least 90 ft in diameter and the shorter range nozzle that will cover the inner part of the circle. The water is distributed in a conical pattern with the heaviest application at the centre, reducing to a feather edge at the periphery, a pattern that has been found by field experience to be most effective. A standard pattern for sprinkler spacing is also in general use. They are placed in line 35 ft to 45 ft apart. This line is moved sideways in steps of 60 ft in order to produce a good overall coverage. The rate of application may vary from 0·2 in to 0·75 in per hour with the same sprinkler according to the nozzle combinations used.

Continued on next page

Building for Little Maintenance and Easy Working

The last decade has seen something of a revolution in farm buildings. New materials and prefabrication methods have replaced the traditional use of purely local timber and stone. There has been a general trend towards a Dutch barn type of building—most commonly of precast concrete or laminated timber—with or without wall filling. Many manufacturing builders do a range of barns in standard sizes that between them cover nearly all farming requirements.

The acceptance of mechanical elevators and portable lifting equipment is having an impact on the layout of the buildings. There is however little sign of two or more storey buildings coming into favour and the traditional loft seems a thing of the past. Single storey buildings with a roof light are in greatest demand, perhaps because they are more easily painted and otherwise maintained, and cheapen lighting bills. Moreover, large clear spans are desirable at ground level to ensure working versatility, and lofts under such conditions are not only very expensive structurally but eliminate the use of roof lights and make the installation of better artificial lighting necessary.

Roof design particularly has shown up the need for standardisation and prefabrication. Site work, both in first construction and for maintenance, has to be kept as low as possible. The lightweight transluscent sheets made from glass fibre set in a polyester resin have proved popular, partly because they give an element of daylight lighting but also because they keep the overall weight of the structure down, requiring nothing more than the simplest of framing and foundations.

Plastic components have possibly found as large an outlet in farm buildings as in any other section of the building industry. Foamed plastic and glass fibre for insulation, plastic guttering and downpipes, tubes for water supply, plastic insulated cables, plastic nuts and bolts for fixing wall and roof sheeting are all in regular use. Their use has probably come about because there is a greater resistance among farmers to spending money on maintenance than among any other section of property owners.

Generally speaking innovations in farm buildings have come from individual farmers and their builders, occasionally with architectural assistance. There has been adequate basic research but there has also been a lack of facilities for development work to bridge the gap between research and practical application; there has also been a lack of deliberate trials of experimental buildings, a type of work that is best carried out on farms that are subject to a wide range of haphazard conditions rather than at central research stations where controlled conditions are a prerequisite.

It was for this reason that, earlier this year, the Agricultural Research Council introduced a scheme of coordinated experiments under which grants (up to a maximum of 50 per cent of the approved cost) would be available for the erection of trial structures or for incorporating experimental features in existing buildings.

The storage of crops has been the subject of basic research for many years both by the Pest Infestation Laboratory and the Building Research Station. Both biological and constructional problems have to be resolved before successful storage is assured, depending on the nature of the crop, the duration of the storage required, and the prevailing climate. Many of these problems are exaggerated in areas of warm climate and, for this reason, there can be especial interest in a new publication from the BRS entitled *Buildings for the Storage of Crops in Warm Climates* (HMSO, 4*s* 6*d*). Many of the points made in this booklet are of direct applications in temperate climates.

In this publication it is pointed out that deterioration is prevented by proofing the store against large vermin; killing small pests by fumigation, contact insecticides or by asphyxiation; controlling moisture and temperature.

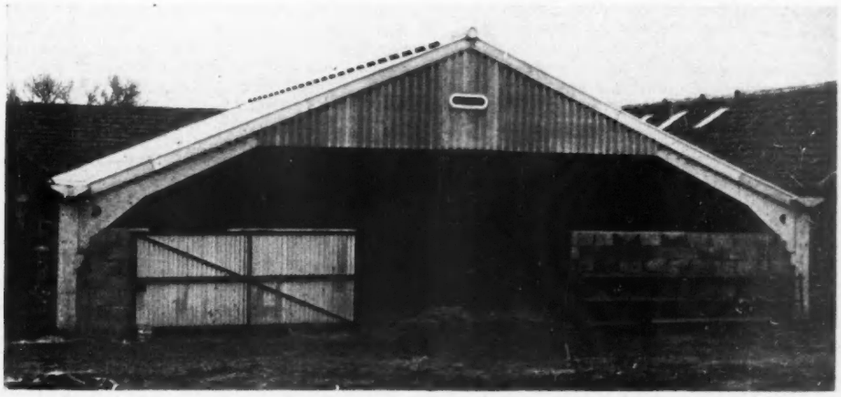
Rats, mice and other large vermin harbour in cavities, particularly those between walls, between ceilings and floors and in stud partitions. They may also nest in the ducts of ventilation or air-conditioning systems. To prevent this nesting cavity walls should be sealed at eaves level and any gaps between roof and walls should be made good with solid material; pipes, shafts and ducts should be sealed against entry, all external pipes being fitted with fine wire guards at open ends and with metal cowls projecting at least 9 in from the pipe. Partitions should be of solid construction and be well sealed to main walls.

Almost the invariable practice is to use concrete for the floors, but two considerations call for special treatments. To discourage infestation, joints must be completely filled with mastic so they are best constructed wider than is general; and to minimise dusting, thereby improving hygiene, the concrete surface is best treated with a hardener, such as sodium silicate.

Many materials can be employed for the walls. Against the advantages of durability possessed by brickwork and concrete must be offset the tendency for them to have rough faces where dust and dirt can collect, though in these days concrete particularly can be made that is extremely smooth and, where necessary, tiles (either traditionally glazed or plastic) can always be fixed, though at a price. Asbestos-cement is resistant to atmospheric pollution but is susceptible to impact damage and to mould growth. Aluminium sheeting can be of great value for both walls and roofs, especially in more tropical climates, because it reflects a lot of the light, so contributing something towards a cool interior.

Whatever the materials used, however, there is still the problem of siting—on a small farm there may be no alternative place for building if the good running of the farm is taken into account. Each site has to be considered on its merits and, if prefabrication is to be used, care must be exercised to choose an appropriate range of structures.

A 40 ft main span covered yard with concrete block infilling. The versatility of this type of structure makes it possible to incorporate it as an extension to existing buildings.



Continuing **More Water for the Farm**

Lightweight low-capacity sprinklers are also available, suitable for garden and nursery use. The water trajectory can be varied from the standard height of 5 ft down to 12 in and they will operate on pressures as low as 5 lb per sq. in, but for good distribution a pressure between 20 and 30 lb per sq. in is recommended. A spacing between sprinklers of 20 ft by 20 ft is used.

The latest development is trickle irrigation, with lines of pipes laid alongside every row of the crop. Small nozzles close to each plant feed water close to the roots without the losses to which spraying is liable.

Frost protection of crops can also be provided by irrigation equipment, automatic control bringing the gear into operation as the temperature falls. The protection of, say, fruit trees or bushes, is obtained by continuously sprinkling them with water throughout the period of the frost. As the water freezes it releases its latent heat and keeps the temperature high enough to prevent damage. Work at the East Malling Research Station has shown that during radiation frosts—which occur on a still night—a precipitation rate of 0·07 in per hour will give protection against a minimum screen temperature of 26° F, while a rate of 0·24 in is sufficient to counter a temperature of 21·5° F. In Britain, spring frosts are rarely as severe as this and a precipitation rate of 0·1 in is normally adequate, but even this represents a consumption of 2,300 gallons per acre per hour.

Such demands for farming are heavy and if developed to the full are likely to prove beyond the existing resources of the water supply companies. In the north, Wales and the west country, it is usual to dam a natural valley and fill a reservoir by trapping the flow of the catchment area; around London, in the home counties of the south-east, water is drawn primarily from deep wells or boreholes into the chalk and river intakes, and then pumped into high level service reservoirs. To date it has been possible to draw on water that is relatively unpolluted; modern plant will make even heavily polluted water potable, but as more " difficult " water is collected costs necessarily rise. More water is available—from deeper wells, from more remote streams, and from points nearer the river mouths, where the water may be more contaminated. It is certain that sufficient water can be obtained to meet all the country's needs, but someone has got to meet the cost.

Farm irrigation raises peak demand to an even higher peak, requiring high capital investment. Someone has to provide the return on the capital investment that may lie idle through much of the year when irrigation is not required. It has been suggested that the answer lies in a complete review of the water tariff structure, towards a two-part system, such as is operated by the electricity supply authorities.

High Hysteresis Tyres Cut Down Skids

The tendency to skid may be reduced by using tyres of high hysteresis rubber with a high coefficient of friction in sliding and rolling. A suitable synthetic rubber polymer combination of the butadiene family has been developed.

By Gordon Wilkins

THE possibility of reducing skids by using tyres made of high hysteresis rubber materials which have a high coefficient of friction in sliding and rolling conditions have been examined by Dr. D. Tabor, at Cambridge, and by the Road Research Laboratory (ENGNG., vol. 186, 1958, p. 838). The indications were that they would have considerable advantages for tyres.

The Research Division at Fort Dunlop has developed a suitable material, a synthetic rubber polymer combination of the butadiene family and it is now being used for a new range of tyres called the Elite. A pilot plant is in operation producing the rubber at the Dunlop synthetic rubber plant. Quantity production, if demand justifies it, may ultimately be undertaken by the International Synthetic Rubber Company, in which Dunlop has a large holding.

Tests have shown that compared with the normal Dunlop Gold Seal tyre, the Elite range gives 24 per cent improvement in road holding on wet roads, 45 per cent greater resistance to wheel spin and a 15 per cent improvement in braking efficiency on wet roads. Another advantage is a great reduction in tyre squeal on corners. Squeal is caused by a vibration set up in the tyre during cornering and is a particular nuisance on luxurious cars which have generously dimensioned tyres operating at fairly low pressures.

The qualities of the new Elite tyre were recently demonstrated on the skid pad at Fort Dunlop, where a curve of 100 ft radius had been marked out. A Jaguar XK 150 coupe fitted with Gold Seal tyres could only reach 33-34 m.p.h. in this curve before spinning out of control on the wet surface. When Elite tyres were fitted to the rear wheels, the car remained under control up to 39 m.p.h.

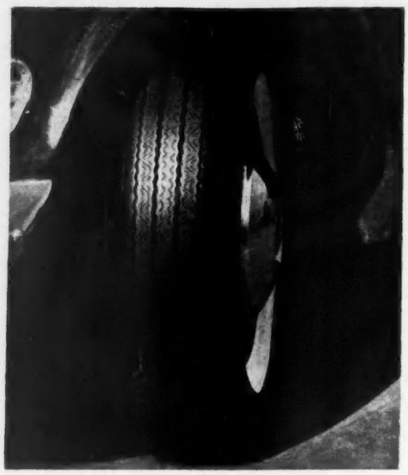
Another test was made with a Jaguar 3·8-litre saloon with the limited-slip differential removed to facilitate wheel spin. With one rear wheel on a surface with high friction coefficient and the other on a wet slippery surface, wheelspin was severe when the throttle was opened suddenly in second gear. When Elite tyres were substituted, using the same tyre section and pressure, wheel spin was completely suppressed.

The third demonstration was a cornering test with a quality car which is known to produce a considerable amount of tyre squeal. Conditions were right for maximum squeal; a smooth traffic-polished bitumen road surface and warm weather, with standard tyres the squeal was the kind that sets people looking for the accident. With Elite tyres of the same section at the same pressure, there was only a gentle swishing noise.

The disadvantage is of course, that these high hysteresis materials convert the energy absorbed into heat and although the Elite tyres have nylon casings, they are not recommended for sustained speeds above about 85 m.p.h. or for maxima over 100 m.p.h. At present they are intended primarily for luxury cars which do a high proportion of urban driving and are priced about 30 per cent higher than conventional tyres. The tread design incorporates a large number of knife cuts to increase wet-weather grip. They are at present made only in tubeless form, prices ranging from £11 6*s* 6*d* for the 6.40-15 to £27 5*s* 6*d* for the white-wall 8.90-15.

However, as costs of synthetic rubber may be as much as 35 per cent below those for natural rubber, it should eventually be possible to make these considerable advantages available in cheaper tyres for the ordinary car owners who never exceeds 85 m.p.h. Such tyres would also give a great increase in safety for riders of scooters, mopeds and motor cycles, who at present suffer disproportionately high casualties.

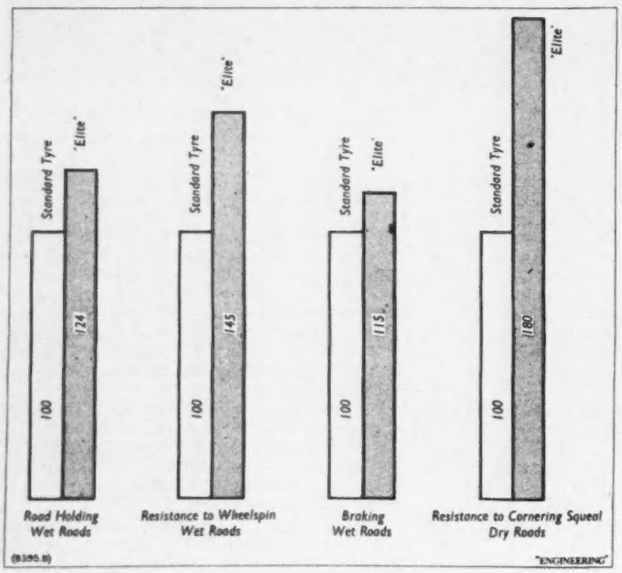
In fast driving, tramlines or ridges in the road can produce a disconcerting sideways jerk as the tyre rides over them if it has a square, angular shoulder. Continental manufacturers have for some time been working to prevent this by designing tyres with round shoulders, on which the tread is continued over on to the side wall. Now Dunlop, working in collaboration with the German Dunlop concern, have evolved a stepped shoulder for their new high-speed tyre, the RS 5 with nylon casing. It allows the tyre to ride up on a longitudinal ridge instead of being deflected by it. New manufacturing techniques have made it possible to include a large number of knife cuts on the centre rib of this tyre, which has seven main circumferential ribs against five on the Elite.



The Elite, a tyre made of high hysteresis synthetic rubber by Dunlop, is said to offer striking improvements in safety, comfort and silence.

In the tyre business, a tug of war now seems to exist between the technicians who, aware of the possibilities of modern materials and tread patterns, would like to see greater specialisation, and the salesmen, whose ideal remains one tyre suitable for all requirements. It is undeniable that to obtain full enjoyment of qualities which are sometimes mutually incompatible, the motorist needs to choose from several different kinds of tyre, but most users are reluctant to keep more than one set per vehicle. An arrangement like the Pirelli BS3, which permits the fitting of various different tread bands to one carcase therefore has obvious attractions.

Properties of Dunlop Elite tyre compared with standard tyre (Dunlop figures).



A Jaguar XK150 spins at 35 m.p.h. on skid pad with normal tyres.

(*Below*) *A Jaguar XK150 holds line at 39 m.p.h. on Elite tyres.*

Mutant Variation

RADIOISOTOPES and radiation have been of great service in promoting the scientists' understanding of the fundamental processes of life. From the point of view of the nuclear industry, the development of radiation techniques in the life sciences has a two pronged effect. On the one hand the application of tracers and radioactive sources in research, engineering, and agriculture creates a demand for the byproducts of the chain reaction, and may result in some reduction in the cost of nuclear power generation. Notable examples are the resale value of control rods, which can be used as powerful radiation sources, and the dual purpose Hallam sodium-graphite reactor which is designed both to produce power and to serve as a gamma-irradiation facility for the preservation of meat.

But perhaps more important than creating a demand for byproducts is the effect of the life sciences upon the understanding of radiological protection. Although radioactivity was discovered over 60 years ago, the knowledge of the long term effects of radiation on the health of the individual and of mankind is still very limited. Standards of radiological protection are set—somewhat arbitrarily—at the most conservative value the industry is thought capable of maintaining. In spite of the conservatism, there is still some uncertainty in predicting the effect of the doses tolerated at present.

Work, mostly with plants and simple organisms, in which the genetic effects of radiation and chemical agents are evaluated and compared may revise the whole concept of radiological protection. This in turn may alter completely the present philosophy on reactor siting, instrumentation, and the provisions for the inspection and maintenance of active reactor components. But much work still remains to be done before the better understanding of genetics can be applied in reactor engineering. In the meantime, the scientists' efforts literally " bear fruit " in unrelated fields such as the production of better crop-plants and the control of agricultural pests, and provide a commercial outlet for radioisotopes.

Genetic Mutations

Mutation is the genetic mechanism involved when an abrupt departure from the original hereditary characteristics of a particular species is brought about. Mutations often occur in nature due to a fundamental change in the germ cell from which the creature or plant has grown. The change may be due to a number of factors which can be caused chemically or by radiation entering the cell and damaging a part of it. These radiations may be of various forms: natural cosmic rays, X-rays, radiation from a nuclear disintegration, or some similar source. Generally mutations are of a harmful nature but a few have been found advantageous for the use of man and many nations are contributing money towards this aspect of nuclear research. The nature of the mutation which is produced cannot be predicted but those which appear to be profitable can be nurtured and those which are harmful discarded. The following illustrate how mutations have been used profitably. In Austria mildew resistant barley has been developed; in Belgium disease resistant and short-strawed cereals have been produced; in France new types of tomatoes have been developed; in Germany higher yielding mutations have been obtained through irradiation of black currants. Fig. 1 shows the mutant variation brought about in a brand of apple as a result of radioactive treatment.

Radiation Protection by Food

The commonest protection from radiation is normally a thick lead or concrete wall; this form of shielding is bulky and heavy and certainly not portable. In an effort to obtain a more convenient method of shielding, experiments are being conducted in the Stanford Research Institute to impart resistance to radiation from certain foodstuffs. It has been found that guinea pigs which had a percentage of cabbage in their diets withstood exposures to radiation better than those which had been deprived of the vegetable in their diet. This form of protection would be especially useful in the case of patients being treated for cancer by radiotherapy.

New Developments in Radiation Protection

Rapid treatment after exposure to radiation has been found successful for promoting recovery at the cellular level. The treatment relies on supplying energy in chemical form to rejoin the chromosomes damaged by radiation. Much has still to be learnt because the effect of certain chemical agents varies widely among different species and strains of microorganisms, and an agent that might have a beneficial effect on one might have the opposite on another, so increasing the number of radiation-induced mutations. S,2-Aminoethylisothiuronium.Br. HBr. (AET) and its related compounds have been closely studied in several different tissues. It is thought that these agents protect against radiation by the quenching of free radicals. Experiments have been successfully conducted in transplanting bone marrow and spleen cells to replace badly irradiated material. A notable instance of this is the replacement of the bone marrow in the five physicists who were exposed to radiation estimated at 680 rem at Vinca near Belgrade (Atomic Review, 20 May, '60). Life span observations of irradiated mice protected with AET and bone marrow transplantation indicate the effectiveness of these agents in reducing the severity of the delayed effects of radiation. (A. Hollaender *et al.*: " New Developments in Radiation Protection and Recovery," *Progress in Nuclear Energy—Medical Sciences.*)

Use of Tracers

Radioactive phosphorus has been widely used in the study of soil which has assisted in the make-up of fertilisers. It has now been found that the movement of phosphorus through the soil is very slow and many crops are not able to take in this element if applied at the surface during the first year of plant growth. Certain plants in the early stages of growth have their roots very close to the surface and so are able to derive some benefit from the fertiliser. But as the plants grow older the roots penetrate more deeply into the ground, and then have to rely upon the natural phosphorus already present in the soil. Fertilising firms are able to derive much assistance from this information. Similarly, other plant nutrients in the soil such as calcium, iron and zinc, have been investigated using the radioactive form of the element as a tracer. The high sensitivity of the radioactive approach allows accurate measurements to be made of the reception rate of the chemical under study in a much shorter time than that possible with the old techniques.

Fig. 1 Mutations in apples, from russet (below) to green skin (above) and an increase in size owing to a multiplication of chromosomes.

Plant and Animal Nutrition

The tracer experiments are unfolding the mechanism of how the minerals are taken up by the roots and travel up the stem. These experiments have also revealed that materials taken up by the tips of roots are largely localised there. Materials applied further from the tip, in the " root hair " zone for example, are moved into the centre of the root and up through the plant. It has also been discovered that some plants can absorb nutrients through their leaves at a higher rate than through their roots. This discovery is causing a rapid development of fertiliser sprays. Figs. 2 and 3 show radioautographs of cotton plants using phosphorus as a tracer. The use of tracer elements has also been developed in animal nutritional studies. An element which occurs in only a few parts in a million can be traced from the food given to the animal through the digestive organs and finally into the tissues without any surgical procedure. This has very obvious advantages and has been used in the study of lactation.

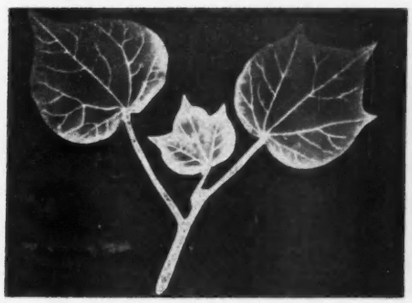


Fig. 2 Radioautograph of a cotton plant supplied with tagged insecticide via the roots.

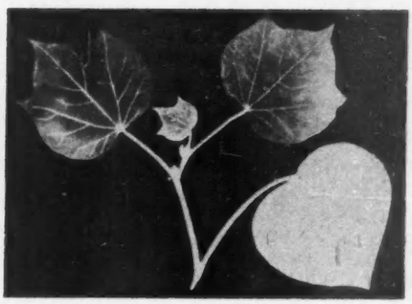


Fig. 3 Similar plant supplied with insecticide to the lower leaf.

Photosynthesis and Fermentation

Perhaps photosynthesis is the most important chemical reaction for the survival of life: in the photosynthetic process the electromagnetic energy from light is absorbed by a plant using the chlorophyll contained in the leaves. This energy is used in converting the inorganic carbon dioxide and water into food substances such as sugar and starch. The exact mechanism of photosynthesis is still not completely understood but the use of atomic energy is again providing a useful tool in its unfolding. Some carbon 14 is added to the carbon dioxide given to the plant: at varying intervals of time various parts of the plant are removed, and the different

chemical compounds separated. Any compound containing carbon 14 must have been derived from the carbon dioxide received by photosynthesis; by this method it is possible to identify each of the steps in the process of the conversion of carbon dioxide into the organic compounds of the plant. The process by which water molecules are split is being studied by nuclear scientists at the University of California. (*Radioisotopes in Science and Industry*—Special Reports of the USAEC, Jan. '60.) Radiology has helped to solve a number of fundamental problems in the fermentation industry and with a complete understanding of the process applying the tracer carbon 14 to yeast it has been possible to devise a method for beer to mature in a tenth of the time normally required.

Food Preservation

The use of radioactive isotopes for the preservation of food is being exploited. The conventional method of food preservation is based on thermal sterilisation in a hermetically sealed container; with this method is associated a loss of some of the natural qualities of the food and often the original properties are changed. The use of sterilisation by gamma and beta radiation dispenses with the thermal treatment. Unfortunately, the irradiation of foodstuff can cause a change in taste and texture by the destruction of certain chemicals, besides sterilising the food. It is therefore necessary to investigate the best possible method to bring about sterilisation without causing a large change in the original product.

Pest Control

It has been estimated that due to the persistence of the weevil and other pests, 5 per cent (26 million tons) of the world's grain supply is lost annually to these famished intruders. Experiments in the Soviet Union and the United States show that a dose of 10,000 roentgen is sufficient either to kill or to sterilise the weevil, and plants are being built to treat the grain accordingly. In the USA leaf rust has been eliminated by radiation. Fungus and plant diseases are the cause of a considerable loss of crops per annum. Fungus diseases cause more damage than that produced by viruses and bacteria. The examination of fungus development is difficult but radioisotopes have accelerated the development of new agents in elucidating the metabolism of the fungus where the classical chemical procedures had failed.

Research in the United Kingdom

Wantage Research Laboratory was officially opened in May of this year. One of the items investigated is the use of radiation in agriculture and medicine. Some of the work follows the lines already taken abroad, particularly in the Soviet Union and the United States where so much fundamental research has been done. Experiments are being conducted to investigate genetic changes produced by radiation and the associated problem of sterilisation; the protection of crops from insects and viruses and bacteria; the preservation of foodstuffs from natural decay.

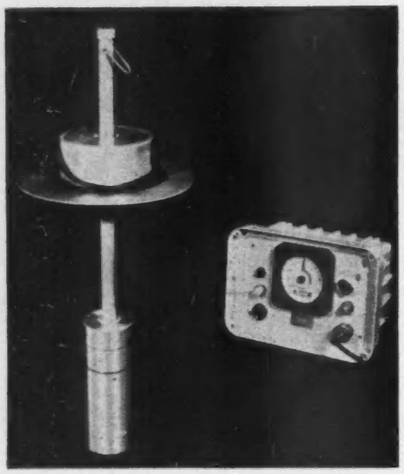


Fig. 4 (left) Two-range dial with opposite needle deflection reduces error in this milk monitor.

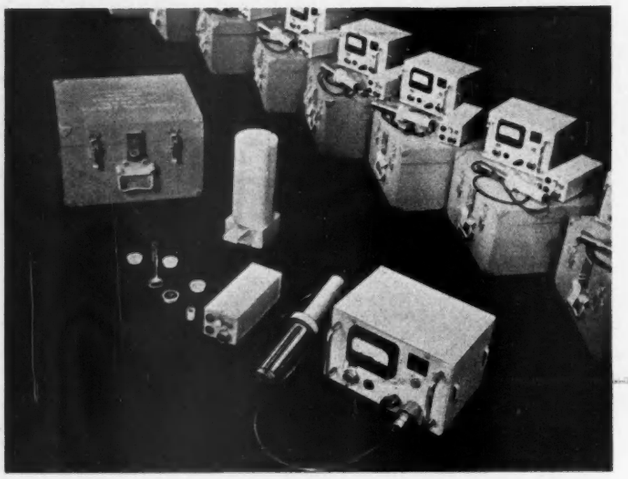


Fig. 5 (right) Food monitors in kit form for field use.

Notes and News

Deuterated Algae

An unusual application of precious heavy-water is being tried at the Argonne National Laboratories of the USAEC. Species of algae are grown in a tank of heavy water to determine the biological behaviour of a living organism in which the body hydrogen has been replaced by deuterium.

Two US Food Irradiation Projects

Two food irradiation centres are to be established in the United States, one by the Army and one by the USAEC for a civilian test project. Both centres will use cobalt 60 and linear accelerators as radiation sources, instead of the original Army project of building a special reactor for the purpose. The scaling down of the military projects indicates the importance of the unrealised hopes in food irradiation: instead of a production plant, the project is still only a large test facility using a one megacurie source. The civilian test plant will use three 25 megacurie sources.

Distribution of Medical Particle Accelerators

A survey of particle accelerators used for medical purposes is published by the IAEA in *Use of Radioisotopes and Supervoltage Radiation in Radioteletherapy*. The following is the distribution of betatrons and linear accelerators by makers:—

Energy	Maker	Linac	Betatron
4 MeV	Metropolitan-Vickers	7	
	Mullard	2	
	Massiot	2	
6 MeV	Stanford	1	
8 MeV	Metropolitan-Vickers	1	
15 MeV	Mullard	1	
	Siemens-Reiniger		12
	Tokyo Shibaura		2
20 MeV	Metropolitan-Vickers		1
24 MeV	Allis-Chalmers		11
31 MeV	Brown-Boveri		6

Radiation Monitors for Contaminated Food

With tolerance levels of radioactive contamination set considerably lower for children than adults, the monitoring of milk for radioactivity is a special problem. Plessey Nucleonics have added a specially designed milk-monitor to their range of standard radiation instruments which is suitable for the rapid checking of bulk shipments of milk. The radiation probe, shown in Fig. 4, is designed for use in standard 10 gallon milk churns. A thin-walled Geiger counter, sensitive both to gamma and beta radiation, comes into operation whenever the probe is lowered into a churn, and the count is shown on a dial calibrated in tolerance levels. Plessey also market a range of radiation instruments suitable for field work in assessing radioactive contamination in liquid or solid foods. Based on the PNI 1045A instrument, the monitor comes in kit form comp' ' with lead castle and auxiliary equipment as shown in Fig. 5.

Information Centre on Food Irradiation

To encourage the successful industrialisation of irradiation techniques in the food industry, the European Productivity Agency—a branch of OEEC—has set up an international information centre at Saclay with the cooperation of the Centre d'Etudes Nucleaires. The first activity of the information centre will be the preparation of a quarterly newsletter designed to promote the flow of information between scientists and industrialists working on problems of food preservation and distribution. Emphasising the international character of the centre, the newsletter will be published in two languages, English and French. A grant of 32,000 NF will cover the publishing expenses.

Reactor Notes

Contractor for Dragon: Turriff Construction Corporation have been awarded the main civil engineering contract for the OEEC Dragon high-temperature reactor project.

Aboriginal Reactor: Australia's second reactor, an Argonaut development, will have the official name MOATA, which means firestick in the language of a native tribe.

Dragon Experiments: Fuel irradiation experiments for the Dragon high-temperature reactor will be carried out in the reactors of five nations: Zenith and Pluto (UK), DR3 (Denmark), Diorit (Switzerland) and R2 (Sweden).

Beryllium Cladding in the United States: Before constructing the gas-cooled heavy-water moderated reactor prototype for the East Central and Florida West Coast Nuclear Groups, the possibility of using beryllium cladding instead of stainless steel will be investigated. Reorientation of the programme will cause a one to two year delay in construction.

Prolongation of OEEC Halden Reactor Project: The European Nuclear Energy Agency has agreed to 1½ year extension to the original 3 year period for the Halden project in order to complete the agreed experimental and research programme. The additional cost is estimated at £762,000.

Organic Cooled Reactor: AEC has assigned to the Phillips Petroleum Company the operation of their experimental organic cooled reactor to be built at Idaho Falls. The design gives a 20 to 40 MW facility.

The

'Engineering' Appointments

Section

THE

NUCLEAR POWER GROUP

requires

ELECTRICAL & MECHANICAL ENGINEERS

To join the Groups commissioning teams at BRADWELL, ESSEX, and LATINA, S. ITALY, nuclear power stations.

Applications are invited from men with experience of testing and commissioning of conventional power station plant.

Nuclear training will be given to successful candidates.

Applications, giving age, qualifications and experience should be addressed to:—

The Personnel Manager,
The Nuclear Power Group,
Radbroke Hall,
Knutsford,
Cheshire.

Quoting reference E/CMS/5.

C 803

PUBLIC APPOINTMENTS

ENGINEERING ASSISTANTS

WESTERN REGION OF BRITISH RAILWAYS require ENGINEERING ASSISTANTS (capable of supervising Drawing Office staff) and TECHNICAL ASSISTANTS experienced in the design of reinforced concrete and steel bridges and other structures to fill vacancies in posts in the salary ranges £1095/£1150 and £875/£948 respectively.

Interesting work in pleasant conditions with promotion on Merit; Superannuation Fund. Reduced rates of travel and other concessions. Five-day week.

Applications, giving age, qualifications and experience, to:—

CHIEF CIVIL ENGINEER
BRITISH RAILWAYS
WESTERN REGION
PADDINGTON STATION
LONDON, W.2

C 798

PORT OF MANCHESTER
ENGINEERING APPOINTMENT

Applications are invited for a Senior position on the staff of the CHIEF ENGINEER.

The position is one which offers excellent prospects of promotion and will carry a salary commensurate with the responsibilities entailed.

Candidates, who must be Corporate Members of the Institution of Civil Engineers, should not only have extensive experience in Dock and Harbour construction and maintenance but should also have first-class executive and administrative experience.

The successful candidate will be required to pass a medical examination and to become a member of the Company's Contributory Superannuation Scheme.

Applications, stating age, qualifications and full details of experience, should be addressed to the CHIEF ENGINEER (marked "Personal"), THE MANCHESTER SHIP CANAL COMPANY, SHIP CANAL HOUSE, KING STREET, MANCHESTER 2, not later than the 30th SEPTEMBER, 1960.

C 808

SCIENTIFIC OFFICER

D.S.I.R. ROAD RESEARCH LABORATORY, SCOTTISH BRANCH, THORNTONHALL, near GLASGOW, requires SCIENTIFIC OFFICER (PHYSICIST OR ENGINEER) for research on oils in relation to road construction. Present work mostly concerned with compressibility properties of peat. Quals. 1st or 2nd Class Hons. degree in Physics or Civil Engineering and, preferably, one or two years' experience. Salary range: (men) £690-£1144. Housing accommodation for married officers probably available in East Kilbride.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting A195/OA.

C 815

TECHNICAL ASSISTANTS

WESTERN REGION OF BRITISH RAILWAYS require TECHNICAL ASSISTANTS to examine and assess the strength of existing girder bridges and structures, and to prepare site surveys. Salary range £875/£948. Interesting work in pleasant conditions with promotion on Merit. Superannuation Fund. Reduced rates of travel and other concessions; five-day week.

Applications, giving age, qualifications and experience, to:—

CHIEF CIVIL ENGINEER
BRITISH RAILWAYS
WESTERN REGION
PADDINGTON STATION
LONDON, W.2

C 797

SCIENTIFIC OFFICERS

BUILDING RESEARCH STATION (D.S.I.R.), GARSTON, near WATFORD, HERTS, requires CIVIL or STRUCTURAL ENGINEERS as SCIENTIFIC/SENIOR SCIENTIFIC OFFICERS for research on concrete construction for nuclear power stations, design of multi-storey buildings, lightweight reinforced concrete, ultimate strength design, earth retaining structures, earth pressures on tunnels, and other projects in structural and civil engineering. Work involves laboratory studies up to model scale and field measurement on actual structures, all with first class facilities. Quals. 1st or 2nd Class Hons. degree in civil or structural engineering. For S.S.O. at least 3 years' post-graduate experience and minimum age 26. Salary ranges (men), S.O. £690-£1144; S.S.O. £1250-£1540.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting E340/OA. Closing date 16 SEPTEMBER, 1960.

C 820

SCIENTIFIC OFFICERS

BUILDING RESEARCH STATION (D.S.I.R.), GARSTON, near WATFORD, HERTS, requires CIVIL or MECHANICAL ENGINEERS as SCIENTIFIC/SENIOR SCIENTIFIC OFFICERS for investigations aimed at modernising building operations, increasing productivity and reducing cost by application of increased mechanisation, new methods of construction and improvement of current building processes. Work will ensure close contact with coming developments in building of all types. Quals. 1st or 2nd Class Hons. degree in civil or mechanical engineering. For S.S.O. at least 3 years' post-graduate experience and minimum age 26. Salary range (men), S.O. £690-£1144; S.S.O. £1250-£1540.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting E.341/OA. Closing date 16 September, 1960.

C 817

AEI A.E.I./DAVY-UNITED DAVY-UNITED

STEELWORKS AUTOMATION UNIT

The Steelworks Automation Unit has been formed jointly by Associated Electrical Industries and Davy-United to apply the most advanced techniques of automation within the steel industry. The work involves development and design in the forefront of the rapidly-growing fields of industrial computers, data handling, and self-optimising control systems.

Engineers, physicists and mathematicians

of high calibre are needed for this work, and there are vacancies for such men, with or without experience in the steel industry, in the fields of:—

Control and Data Handling	Operational Research
Digital Computer Techniques	Mathematical Analysis
Instrumentation	Computer Programming

If you want to join a new and exciting venture which will provide you with real satisfaction, and excellent prospects in an expanding field of endeavour, write to the address below for an interview, giving a summary of your academic attainments, practical training and experience, and brief personal details.

Ref. WS/SAU,
A.E.I./Davy-United Steelworks Automation Unit,
Mill Road, Rugby, Warwickshire.

C 801

ICI

METALS DIVISION - RESEARCH

A MECHANICAL ENGINEER

is required to lead a research team engaged in the field of the plastic deformation of a wide range of metals, which include titanium, zirconium, beryllium, and other industrially new metals. Processes include rolling extrusion, pressing and drawing. The work is primarily investigational and involves the full range from short term assistance to the mills to fundamental investigations aimed at increasing understanding of the processes used. Some design of instruments and small scale and prototype plant is also involved.

Excellent semi-technical scale equipment is available. The post also includes responsibility for a machine shop and small drawing office which serve the Division Research Department as a whole.

Candidates, preferably in the age range 30/40, should have an honours degree in engineering and have undertaken either university or industrial research. They should also have some knowledge of the subject of plasticity or of some part of the metallurgical industry.

There is a good starting salary, dependent on age and experience with excellent prospects of advancement. The appointment is pensionable and there is a profit-sharing scheme in operation. Assistance can be given to a married man towards house purchase and removal expenses.

Please write for an application form to the

Assistant Personnel Manager (Staff),
IMPERIAL CHEMICAL INDUSTRIES LIMITED,
Metals Division,
P.O. Box 216, Kynoch Works,
WITTON, Birmingham 6.
quoting RES/438/ENG.

C 812

UNIVERSITY OF GLASGOW
DEPARTMENT OF MECHANICAL ENGINEERING
STEAM POWER SECTION

Applications are invited from Honours graduates in Engineering for Research Studentships, tenable in the above Department. The Studentships are of the value of £550 per annum. The appointments are in connection with an extensive programme of research on topics associated with Steam Generation at advanced conditions, which is being carried out under a recurrent grant from the Electricity Supply Research Council.

The work now in progress comprises investigations on the properties of materials at high temperatures, chemical behaviour and transport and thermodynamic properties of steam.

The Research Studentships will be tenable for three years and should normally lead to a higher degree.

Applications (3 copies) should be lodged, not later than 12th SEPTEMBER, 1960, with the SECRETARY OF THE UNIVERSITY COURT, THE UNIVERSITY, GLASGOW, W.2.

ROBT. T. HUTCHESON,
Secretary of University Court. C 793

AIR MINISTRY

AIR MINISTRY Works Designs Branch requires in LONDON CIVIL ENGINEERING DESIGNER DRAUGHTSMEN with adequate training and drawing office experience in one or more of the following:—

(*a*) Roads, pavements, earthworks and storm-water drainage.
(*b*) Foul drainage and sewage disposal.
(*c*) Water supply and distribution.

Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 days paid leave per year initially. Salary ranges from £680 (at age 25) to £900 per annum. Commencing salary dependent on age, qualifications and experience. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.G.d. LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or apply to any Employment Exchange quoting King's Cross 3746 giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 889

JAMAICA COLLEGE OF ARTS SCIENCE AND TECHNOLOGY KINGSTON

Principal: H. FALKNER, M.Sc.(Wales), B.Sc.(Lond.), A.Inst.P.

Applications are invited for appointment as SENIOR LECTURER IN MECHANICAL ENGINEERING.

Salary scale: £1300 by £50 to £1550 but likely to be revised to £1500 by £50 to £1750.

Appointment will be made above the minimum according to qualifications and experience. Appointment may be either permanent or on contract. Possible housing assistance. The College is a rapidly developing one.

Further information obtainable from COUNCIL FOR OVERSEAS COLLEGE, 12, LINCOLN'S INN FIELDS, LONDON, W.C.2, to whom applications (6 copies) giving age, qualifications, experience and names of 3 referees should be sent by 6th SEPTEMBER, 1960. C 816

THE NIGERIAN COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY FACULTY OF ENGINEERING OF UNIVERSITY COLLEGE, IBADAN, AT NIGERIAN COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY

Applications are invited for the CHAIR OF MECHANICAL ENGINEERING. Salary scale (contract) £3400 p.a., including contract and inducement addition. Equivalent of existing F.S.S.U. contributions or tax-free gratuity at £150 p.a. Free first class passages (up to a maximum of four adult passages) on appointment, termination and annual leave in U.K. Part-furnished quarters at low rental. Children's U.K. maintenance and other allowances. Appointment normally on contract for two sessions in first instance and renewable. Appointments on secondment may also be considered on the same terms. Detailed applications (8 copies) naming three referees as soon as possible to SECRETARY, INTER-UNIVERSITY COUNCIL FOR HIGHER EDUCATION OVERSEAS, 29 WOBURN SQUARE, LONDON, W.C.1, from whom further particulars may be obtained. C 819

TECHNICIAN

MINISTRY OF AVIATION requires a TECHNICIAN at HAREFIELD, MIDDLESEX, to carry out high precision measurement on interchangeability media and on aircraft, engine and guided weapon parts. Work sometimes involves complex calculations and requires considerable ingenuity in evolving methods of inspection. Quals. Recognised engineering apprenticeship. O.N.C. C. & G. Final Certificates or equivalent. Thorough knowledge of the methods of precision measurement, backed by practical experience. Salary, £900 (age 30)-£1065.—Application forms from MANAGER (P.E.2531), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. C 818

MANCHESTER CORPORATION WATERWORKS UNDERTAKING

Applications are invited for the appointment of DEPUTY ENGINEER AND MANAGER of the Manchester Corporation Waterworks Undertaking. Applicants should be Civil Engineers with administrative experience, preferably having a wide experience of the design and construction of large civil engineering works for water supply.

Commencing salary £2753 per annum.

Details of appointment and application forms (returnable by 26th September, 1960) from the SECRETARY, WATERWORKS DEPARTMENT, TOWN HALL, MANCHESTER 2. C 822

BRADFORD INSTITUTE OF TECHNOLOGY

Applications are invited for the following posts:—

READER IN MECHANICAL ENGINEERING

Candidates should possess the qualifications and experience to direct research and post-graduate work and to take a leading part in advanced teaching. Importance will be attached to industrial and research experience. Adequate facilities will be given to undertake research and suitable technical assistance and equipment are available.

Salary £1800-£2100 per annum (or above in special cases).

PRINCIPAL LECTURER IN MECHANICAL ENGINEERING

Candidates should be qualified to teach to final degree and Diploma in Technology standard and should have adequate research and industrial experience. The successful candidate will be expected to assist the Head of the Department with the organisation and administrative work of the Department and will be encouraged to develop industrial contacts.

Salary £1750-£1900 per annum.

Previous industrial or research experience at a suitable level will be taken into account in fixing the commencing salary.

Senior members of staff are encouraged to undertake consultant work in industry and may retain fees paid for such work.

Further particulars and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

HENRY PATTEN,
Clerk to the Governors. C 823

SOUTH EASTERN GAS BOARD
DESIGN DRAUGHTSMAN
CENTRAL CONSTRUCTION DEPARTMENT
AREA HEADQUARTERS
KATHARINE STREET, CROYDON

Applicants should have a sound engineering training and have experience in design and construction of Refractory Brickwork and of Coal Carbonising and Gasification Plants.

Salary within Grades 8 or 9 (Met. Area) £865-£965 or £930-£1050 per annum, according to qualifications and experience.

Applications, quoting reference V15/1309 and giving full details, should reach the PERSONNEL MANAGER, SOUTH EASTERN GAS BOARD, KATHARINE STREET, CROYDON, SURREY, within seven days. B 824

APPOINTMENTS OPEN

FORENSIC ENGINEERS

FORENSIC ENGINEERS invite application from Engineering Graduates with good background and industrial experience for responsible and individualistic post. Age not over 35.—BOX C 799, Offices of ENGINEERING.

THE BOWATER ORGANISATION

Applications are invited from men under the age of 45 years for the following vacancies which will shortly arise in our modern Power Plant:—

DEPUTY POWER ENGINEER. Applicants must be capable of the technical supervision of a modern high pressure boiler plant and should have had technical training up to Institution standard followed by at least five years practical experience in a responsible position in the operation of a modern boiler plant including oil burning equipment.

ASSISTANT SHIFT POWER ENGINEER. Applicants should have technical training to Ordinary National Certificate level with practical experience in the operation of a modern high pressure boiler plant and oil burning equipment.

Applications giving details of age, training and experience, should be addressed to the MILL MANAGER, BOWATERS UNITED KINGDOM PULP AND PAPER MILLS LIMITED, THAMES DIVISION, NORTHFLEET, KENT. C 792

MECHANICAL DESIGNER

MECHANICAL DESIGNER required by expanding firm manufacturing heat exchangers of various types and pressure vessels. Applicants, aged 28-40, must be fully experienced with design requirements of the various codes, and able to work to thermal design data without supervision. Non-contributory Pension Scheme in operation. Location, Gloucester area.—BOX C 806, Offices of ENGINEERING.

MECHANICAL, ELECTRICAL AND CIVIL ENGINEERS

MECHANICAL, ELECTRICAL AND CIVIL ENGINEERS required by North Eastern engineering office dealing with industrial power plants and electrification schemes. The applicants, who should be aged between 28 and 35 years, should be keen and able to work with minimum supervision. Minimum qualification is H.N.C. together with good experience in Thermal Plant/Electrical design layout and the ability to handle Contract work. Contributory Superannuation Scheme. Reply giving full details of age, experience and present salary to BOX C 770, Offices of ENGINEERING.

DESIGNER/DRAUGHTSMAN

DESIGNER/DRAUGHTSMAN required for small but expanding Company in SOUTH BUCKS to extend their range of Centrifugal Pumps and other projects. Candidates must have experience of pump applications including hot water circulation duties and be able to work without supervision.—Apply stating age, experience and salary required, to: BOX C 728, Offices of ENGINEERING.

CHEMICAL OR MECHANICAL ENGINEER

THE ELECTRICAL WELDING DIVISION OF THE B.O.C. GROUP OF COMPANIES requires a CHEMICAL OR MECHANICAL ENGINEER to undertake design and development work of new manufacturing plant. Candidates should be graduates or members of a senior professional institution and should preferably have had experience of the design of modern mass production equipment or wire handling machinery.—Apply in writing to STAFF PERSONNEL OFFICER, QUASI-ARC LTD., BILSTON, STAFFS. C 758

DEVELOPMENT ENGINEER

DEVELOPMENT ENGINEER for GASKET MANUFACTURERS, SLOUGH, to be responsible for research into sealing problems, for conducting an Advisory Service to customers and for controlling the present Test Laboratory.

A technical training, including some practical foundry experience, several years' experience of automobile engine design and testing, and ability to get on with people are indispensable.

Age up to 60 will be considered, providing in good health. A good salary commensurate with responsibility will be paid.

All applications will be treated in the strictest confidence.

Write to MANAGING DIRECTOR, COOPERS MECHANICAL JOINTS LIMITED, LIVERPOOL ROAD, SLOUGH, BUCKS. C 759

DRAUGHTSMAN DESIGNER

DRAUGHTSMAN DESIGNER required for Equipment Department (responsible for new layouts, etc., in various parts of Fort Dunlop factory). The work covers mechanical handling and/or design of automatic and semi-automatic machinery for rubber processing and tyre manufacture. (Rubber experience not essential but applicants should know something about mechanical handling and/or special-purpose machine design in other industries). Holiday arrangements respected. Pension scheme; five-day week; excellent working conditions. Age range: 25-43.—Please write, giving brief details and commencing salary required, to STAFF OFFICER (REFERENCE E), EMPLOYMENT DEPARTMENT, FORT DUNLOP, ERDINGTON, BIRMINGHAM, 24. C 753

ASSISTANT SECRETARY

THE INSTITUTION OF GAS ENGINEERS invites Applications not later than 12th SEPTEMBER, 1960, for the Appointment of ASSISTANT SECRETARY at a commencing salary of £1750 per annum. Conditions from the SECRETARY, THE INSTITUTION OF GAS ENGINEERS, 17, GROSVENOR CRESCENT, LONDON, S.W.1. C 755

THE REPUBLIC OF THE SUDAN

Applications are invited from those suitably qualified to fill a vacancy of Estimator (Quantity Surveyor) in the Sudan Railways. Candidates should be Corporate Members of the R.I.C.S. or I.A.A.S. with an engineering background and have had at least five years' practical experience in estimating buildings, bridges, harbour works and railways.

Age 30-45 years.

Appointment will be on contract with bonus for a period of three years in the salary range £S.1075-£S.1975, and the starting point will be determined according to age, qualifications and experience. A cost of living allowance is payable and an initial outfit grant of £8.50 is paid on appointment. There is no income tax payable in the Sudan (£S.1 equals £1 0s. 6d.)

Annual home leave on full pay will be accrued at the rate of seven days per month. Free passage on appointment for official and family.

Applications should be made in writing to the APPOINTMENTS SECTION, SUDAN EMBASSY, 3 CLEVELAND ROW, ST. JAMES'S, LONDON, S.W.1, giving full particulars of qualifications, experience and age, together with copies of two recent testimonials and quoting reference 4/1938.

Closing date 15th SEPTEMBER, 1960. C 814

TRAVELLER OR AGENT

HAND CLEANING PASTES AND JELLIES. A leading manufacturer requires a TRAVELLER OR AGENT (exclusive) calling on factories and heavy engineering works in Lancashire and Yorkshire. An excellent opening for a man who is conversant with the business.—BOX C 805, Offices of ENGINEERING.

DRAUGHTSMEN
and
DESIGNERS

Required by Crawley Industrial Products, Ltd., for their new factory at Llanelly.

Only engineers with plenty of drive and initiative need apply as the Company is starting on a major development and expansion programme.

Experience in the design of Underground Mining Machinery will be an advantage but not an essential qualification.

Designers to be within the age group 25-35 and to have H.N.C. as a minimum qualification.

Draughtsmen to be within the age group 21-30 and must possess at least the O.N.C.

Interested and sincere applicants only should apply stating age, experience, qualifications and salary to:—

CRAWLEY INDUSTRIAL PRODUCTS, LIMITED
46/48 WELLESLEY ROAD,
CROYDON, SURREY C 813

APC
RESEARCH & DEVELOPMENT
DEPUTY HEAD
of
GENERAL SERVICES DIVISION

A vacancy has arisen due to expansion for a man aged 30-40 to co-ordinate, plan and progress the work of the Division which provides rig design, installation and maintenance, and manufacturing facilities for the Research Staff of the Laboratories at Heston, Middlesex.

Applicants must have wide experience in mechanical and electrical engineering and should preferably have H.N.C. or other professional qualification.

Full details should be sent to:—
THE PERSONNEL MANAGER (Ref. E/136),
ATOMIC POWER CONSTRUCTIONS LIMITED,
P.O. BOX 90,
28 THEOBALDS ROAD, W.C.1 C 789

U.K.A.E.A.
HARWELL REACTOR SCHOOL
STANDARD COURSE No. 22

The next course will be held from 2nd JANUARY to 28th APRIL, 1961, inclusive. The fee for the course is £250 exclusive of accommodation.

It is intended primarily for engineers and physicists whose main interest is in reactor design.

Control and Instrumentation of Reactors Course No. 6

This course will be held at Durley Hall, Bournemouth, from the 30th January to 10th February, 1961, inclusive. The fee for the course will be £52 10s. 0d., exclusive of accommodation.

It is intended for those who have a direct interest in the control and instrumentation of nuclear reactors, and it is assumed that participants have some knowledge of the basic principles of these subjects.

Senior Technical Executives' Course No. 12

The course will be held from 8th to 19th May, 1961, inclusive, of which the first week will be at The Reactor School, Harwell, and the second at Durley Hall, Bournemouth. The fee for the course is £52 10s. 0d., exclusive of accommodation.

This is an appreciation course for senior executives and gives the background to nuclear engineering.

Application forms and further details for these courses can be obtained from:—

THE MANAGER,
REACTOR SCHOOL,
A.E.R.E.,
HARWELL,
BERKS. C 794

DESIGNER/ENGINEER

DESIGNER/ENGINEER required to assist in the development of new mechanisms. Applicants must have served a practical apprenticeship and may be either mechanical engineers with some electrical knowledge or electrical engineers with strong mechanical associations. They should be qualified to G.I.Mech.E. or G.I.E.E. standards. The successful applicant will essentially possess a flair for mechanisms and be able to think in three dimensions Salary according to experience in the range £1000-£1500 p.a. Preferred age group 25-35.—Applications, giving details of qualifications and previous experience, should be addressed to W. J. FRASER & CO., LTD. ROMFORD, ESSEX. Ref. DEV/GTK C 809

Plessey

Following the retirement of the Company's

CHIEF WORKS
METALLURGIST/CHEMIST

applications are invited for this appointment which involves professional consultancy to senior management and technical staff of the Company's factories, control of the Central Chemical and Metallurgical Laboratories at Ilford, and liaison with customers at senior level.

The materials covered include ferrous and non-ferrous metals, magnetic materials, ceramics, rubbers and resins as used in electronic component manufacture. Experience in the supervision of chemical, metallurgical and physical tests on such materials is essential.

Candidates should possess an Honours Degree in Chemistry or Metallurgy, though a high qualification of the appropriate professional body would be acceptable.

Applications, which will be treated in the strictest confidence, should state age, experience and qualifications and be sent to A. M. BROWN, Executive Director (Personnel),

THE PLESSEY COMPANY LIMITED
Vicarage Lane, Ilford, Essex. C 791

QUALITY CONTROL
In
LIGHT ENGINEERING

An opportunity has arisen for a qualified engineer who has specialised in all aspects of modern inspection and quality control techniques as applied to light mechanical (and some electrical and plastics) engineering products. This post of Chief Inspector calls for executive experience in this field, covering precision work as well as semi-mass production runs; academically, I.P.E. corporate membership or its equivalent is desirable; candidates must have a background of approval by Ministries and nationalised industries. Salary and other conditions will be commensurate with the post and with the successful candidate's qualifications and experience; prospects within the Group are attractive.

Write in the first instance, with all relevant details to:—

THE WALLACE ATTWOOD COMPANY
West Halkin House, West Halkin Street,
London, S.W.1.

who are acting on behalf of the Company. No approaches will be made to present employers without the candidate's approval. C 821

Hawker Siddeley Aviation
LIMITED

GUIDED WEAPONS

A. V. ROE & CO. LTD.
Weapons Research Division, Woodford Aerodrome, Cheshire

DESIGN AND LIAISON ENGINEERS FOR 'BLUE STEEL' GUIDED MISSILE DESIGN TEAM

Vacancies exist for Design and Liaison Engineers to work on:—

1. Missile Ground Handling Equipment and Test Equipment.
2. Conversion of aircraft for use in trials.

These posts offer a wide scope for applying and gaining experience on a modern weapon system. Applicants must have had relevant experience on either aircraft or missiles.

The Division is situated at Woodford, Cheshire, in country surroundings near the Derbyshire hills, is well served by main bus routes and is close to housing and shops.

Apply, quoting Ref. R.213/E, to the
Personnel Manager,
A. V. ROE & CO. LIMITED,
Greengate, Middleton, Manchester C 802

CHARTERED PATENT AGENT
ENGINEERING

A leading industrial company engaged in a wide field of manufacture of which engineering forms a substantial part, both in the United Kingdom and overseas, requires a senior qualified Patent Agent having a degree in Engineering. The post is based at the Company's operating headquarters in the Midlands and the work is varied and interesting. Initial salary not less than £2,000 per annum, pension scheme and excellent terms of service. Preferred age under 35. *Reference Number* 95.

Please reply in confidence, quoting reference number, to:—

Robert Clive (Consultants) Limited

27, ALBEMARLE STREET, LONDON, W.1

C 800

APC

RESEARCH & DEVELOPMENT
CHIEF DESIGNER

Expansion of the Company's Laboratories at Heston, Middlesex, has created a vacancy for a man aged 30-40 to be responsible for the design of test rigs and other laboratory equipment.

Applicants should have several years experience in a similar capacity and qualifications to at least H.N.C. is desirable.

Full details should be sent to:—

THE PERSONNEL MANAGER
(Ref. E/134)
ATOMIC POWER CONSTRUCTIONS LIMITED,
P.O. BOX 90,
28 THEOBALDS ROAD, W.C.1

C 788

ELECTRICAL ENGINEER

An important BRITISH GOLD MINING COMPANY IN GHANA wishes to appoint an ELECTRICAL ENGINEER. The successful candidate will be responsible to the Chief Engineer for the maintenance of all electrical plant and machinery on the surface and underground and for the installation of all new electrical equipment. He should have experience in power generation and distribution and in the maintenance of records and ordering of spares. Previous Mining Engineering experience essential; technical qualifications at least up to H.N.C. (Electrical) standard.

Starting Salary not less than £1750 per annum.

Tours abroad are for 15 months followed by 3 months' paid leave, passages and housing provided. The post is healthy and suitable for children. The appointment is permanent and pensionable. Income Tax at low local rates.

Applications, which will be treated in confidence, should give details of technical training, practical experience and positions held and should be addressed to BOX C 807 Offices of ENGINEERING.

WORK STUDY ENGINEERS

WORK STUDY ENGINEERS are invited to apply for vacancies that offer temporary engagements, at advantageous terms of 1 to 2 years' duration, in a light Engineering factory situated in the Midlands.

The project involved is of importance and concerns review, re-study and implementation of Company Policy in the application of Work Study affecting several thousand employees.

Permanent posts will be available to some participants on completion of this project.

Applicants should write, quoting E/M, stating age, qualifications and experience, to THE PERSONNEL MANAGER, BOX C 700, Offices of ENGINEERING.

BICC

BRITISH INSULATED CALLENDER'S CONSTRUCTION CO., LTD.

have vacancies in their Overhead Line Contracts Department in London for:—

ASSISTANT DESIGN ENGINEERS

Work involves structural design aspects of Electrical Transmission and Distribution Lines. Previous experience desirable although not essential but structural background up to H.N.C. standard an advantage. After appropriate training successful applicants will be expected to conduct technical correspondence and negotiations. These posts carry progressive responsibility.

DRAUGHTSMEN

The work involves the preparation of arrangement and detail drawings for Electrical Transmission and Distribution Lines. The posts offer advancement to the status of Designer Draughtsmen.

Write, stating all details, including age and salary required, to:—

Staff Officer,
B.I.C. CONSTRUCTION CO. LTD.,
30, Leicester Square, London, W.C.2

C 811

WANTED FOR A BRITISH CONTROLLED COMPANY IN SOUTH INDIA ENGAGED IN THE TEXTILE AND ENGINEERING INDUSTRIES, AND IN GENERAL TRADING:—

1 A Deputy Chief Engineer.

Candidates for this appointment should be highly qualified Electrical Engineers, not more than 40 years of age, with experience in handling large Power Generation Contracts. Qualifications, or experience in general Mechanical and Structural Engineering and Works Control are desirable and would be a considerable advantage.

2 A Design and Contracts Engineer.

Candidates for this appointment, who should be between 30 and 40 years of age, should have considerable experience in the design and layout of modern Sugar Factories complete with Boiler Plant, Centrifugal Station, piping arrangements, etc., A.M.I.Mech.E. or similar qualification is desirable and knowledge of Chemical Engineering would be an advantage.

3 A Machine Shop Superintendent.

Candidates for this appointment, between 30 and 40 years of age, should have sound and varied practical and technical experience to enable them to take charge of light and medium/heavy Machine Shops working on plant and products for a wide range of industries. They should have held a position of Superintendent or Foreman for a period of not less than 5 years.

Good salaries on rising scales are offered according to the age and capabilities of the applicant. Free furnished quarters are provided, free medical attention for employees and wives, retiring benefits, home leave and free passages including wives and children. The first contract is for a period of 3 years.

Write stating age, qualifications, whether married or single, and details of any family to:—

BOX Z.S.82,
DEACONS ADVERTISING,
36, LEADENHALL STREET,
LONDON, E.C.3

C 825

Another Opportunity in Iron and Steel

BISRA

The Association has a vacancy for a

GRADUATE CIVIL or MECHANICAL ENGINEER

in its Engineering Laboratories in London. The research, which is varied and interesting, is particularly directed to solving special structural problems in the steel industry by the application of modern techniques of design and stress measurement. An Honours degree in civil or mechanical engineering is preferable but not essential. Some experience of stress measuring techniques together with some knowledge of framed structures and their foundations would be an advantage. The successful applicant will be able to publish the results of his research.

Starting salary up to £1,080, according to age, qualifications and experience. The post is superannuated under the F.S.S.U.

Written applications only, quoting E18, to the **Personnel Officer, The British Iron and Steel Research Association, 11, Park Lane, London, W.1.**

C 829

TAYLOR WOODROW CONSTRUCTION LIMITED

offers excellent opportunities on nuclear power stations and other important industrial work at the Head Offices in Southall to:

SENIOR DESIGN ENGINEERS

Conditions of employment are attractive.
A Pension Scheme is in operation.
Write giving brief details of career and availability for interview to:

Personnel Manager,
345 Ruislip Road,
Southall, Middlesex.

C 826

MECHANICAL ENGINEERS

MECHANICAL ENGINEERS aged 25/33 years with at least H.N.C. qualification are invited to apply for a position in our Development and Installation Department. The work involved requires a good knowledge of the mechanical aspects, performance, and layout of wrapping and packaging machinery, and a keen interest in experimental and production projects associated with the Confectionery Industry. The salary to be paid will be commensurate with experience and qualifications.—Please reply giving full personal details of education, training, experience to PERSONNEL MANAGER, JAMES PASCALL LIMITED, STREATHAM ROAD, MITCHAM, SURREY. C 810

APPOINTMENT WANTED

ENGINEERING MANAGER

CHARTERED MECHANICAL ENGINEER, 15 years' supervisory and management experience in Design, Development, project and product engineering, 8 years in North America. Recently returned to this country, immediately available and prepared to locate in any district. Seeking challenging executive post requiring initiative and responsibility. Experienced in mechanical, hydraulic, light structural and sheet metal industries; jobbing, batch and mass production techniques. Proven administrative capability.—BOX C 795, Offices of ENGINEERING

CANADIAN EXPERIENCE

British degree 1956 E.E., now in charge commissioning control equipment from magamp steel mill drives, to power system relaying. Desire position offering broad experience. Available for interviews September.—BOX C 804, Offices of ENGINEERING.

ADVERTISEMENT RATES

'Engineering'

Appointments Section

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Rates: per page (12 in. by 9 in.) .. £100
per half page £54
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Companies

A New Ship and a New Air Company

WITH the home market booming merrily it does not follow that shipping, which is dependent upon the level of imports and exports, has necessarily benefited.

Sir Nicholas Cayzer, chairman of the BRITISH AND COMMONWEALTH SHIPPING Company, describes in his annual report how shipping has not so far shared the recent relative prosperity of the home market.

Rather, as he says, has the situation been one of too many ships chasing too few goods. So far as the carriage of British goods is concerned the recent trade figures can give Sir Nicholas no grounds for hope of improvement in that quarter.

Two of the oustanding events of the year for the company are its merger with the independent air operating company AIRWORK to form the BRITISH UNITED AIRWAYS Company, and the completion of the new "Windsor Castle". The date for the new liner to sail on her maiden voyage to the Cape, 18 August, was fortunately not upset by the seamen's unofficial strike.

Of the shipping scene generally, the chairman was able to report that in 1959 the rate of ship scrapping had at last begun to increase. Although British and Commonwealth is making its contribution to scrapping it sold the Bloemfontein Castle.

This was because she was of fairly recent construction but no longer fitted into the pattern of the company's operations. The overall policy of the company, and one being increasingly adopted by other shipowners, is not to sell ships to those in a position to use them cheaply against established shipping firms.

Of the Airwork merger, Sir Nicholas said that since this was the day of the big battalions the move strengthened their air interests and gave both sides a chance of a better future.

British Commonwealth and Shipping has, of course, a special connection with Africa and the chairman referred to "the many problems" of that continent. While he was confident that a solution would be found, an enormous amount of good statesmanship, sagacity and goodwill to make progress at the proper rate would be needed.

From Liners to Handyman Drills

From its hopes to build at Clydebank the replacement liner for RMS "Queen Mary," to plans for new products from S. N. BRIDGES, the portable electric tool firm, the future of JOHN BROWN AND COMPANY is spread through a wide field of engineering.

In his annual review Lord Aberconway, the chairman, reports that the number of ships under construction or to be laid down at Clydebank, is only eight. In the past year only one order was received, this was for a refrigerated cargo vessel for the NEW ZEALAND SHIPPING Company.

If the John Brown yards are not given the building of the new Cunarder they will, in the chairman's words, be very short of work. Even if Clydebank does receive the order for the new express liner there will still be capacity for further naval or mercantile construction.

John Brown engineers engaged in a long cooperation with the CUNARD STEAM-SHIP Company over the design studies for the new liner which the Chandos committee subsequently approved.

Difficulties

The group is committed to a variety of fields in which for some time the reports consistently have been of falling profit margins, of unremunerative contracts, all the result of sharply intensifying competition. Shipbuilding, heavy engineering, building large boilers, rolling stock, machine tools, these conditions apply to all of them and the group is engaged in each one.

While JOHN BROWN LAND BOILERS has been busy erecting and commissioning boilers ordered several years ago there will soon be very few orders remaining to be carried out. The only order the company has received from a British generating authority in the last four years has been the order for a boiler for Bankside power station, which came into the previous financial year.

Despite the recent addition of a thermal station to the programme of generating capacity, and hopes that some further increases may be made, the future of this subsidiary is seen by Lord Aberconway as far from assured.

The much livelier demand for machine tools affected the group's machine tool companies. WICKMAN Limited enjoyed in the latter half of the year, a very considerable increase in the demand for multi-spindle automatics. This was mostly from car makers and domestic appliance firms at home or abroad. Last year orders for automatics reached record levels. Delivery dates, which had been brought down to six months, lengthened to eighteen.

WEBSTER AND BENNETT, in full production during the year, reached their highest output of vertical boring and turning mills. Although the number of orders coming in has improved it is still below the factory's capacity. A moderate reduction in the production programme is forecast later in this financial year. Labour wastage is sufficient to avoid redundancy.

Future Machine Tools

At FIRTH BROWN TOOLS Limited a new research department on machinability is almost complete. Its equipment includes a new test lathe with exceptional speed and power. Lord Aberconway describes this lathe as for the exploration of the next generation of machine tools designed to exploit more fully the potential of carbide and ceramic tools.

Meeting increased competition in portable electric tools, S. N. BRIDGES still succeeded in stepping up its turnover. The new factory in Battersea makes greater output and efficiency possible and has a good deal of scope for expansion. Plans are well advanced for the launching of new products.

Among the diverse activities of the foreign subsidiaries one of the most interesting is in Brazil where Wickman have taken a majority holding in a local company, BRASMAC, changing the name to BRASMAC WICKMAN. A factory has been built at San Paulo where sparking plugs and automobile components are being produced.

The manufacture of tungsten carbide tools is to be begun shortly. Recognising the risks, financial, commercial and political, the John Brown directors believe that to the inevitable expansion of South America British industry can make a useful and profitable contribution.

The group's consolidated profit before tax was £3,645,000, an increase over the previous year of £292,000.

Sound Order Book at Metal Industries

METAL INDUSTRIES Limited which, due to the purchase of LANCASHIRE DYNAMO, is now well over twice the company it used to be, is in a strong position on the order book and the chairman, Sir Charles Westlake (inset), expects that

the satisfactory profit level of the past financial year will be maintained in this.

The trading profit for the pre-merger Metal Industries companies was £1,722,715, compared with £1,503,963 in the previous year. For the Lancashire Dynamo companies the profit for the year up to 31 December, 1959, was £863,273, against £836,466 for 1958.

Considering the combining of the two groups, which increased the number of MI subsidiaries from 16 to 38, and doubled the number of employees to 12,000, Sir Charles Westlake says that integration will take some time but the problems are being resolutely tackled.

The merger was brought about for the expansion of MI's interests in power systems and controls and it is in this field that the chairman includes in his annual report some information on expanding capacity. Important extensions are being made to the Rugeley works of LANCASHIRE DYNAMO ELECTRONIC PRODUCTS.

FOSTER TRANSFORMERS Limited, at Wimbledon, London, SW, and Leatherhead, Surrey, and LANCASHIRE DYNAMO NEVELIN Limited, of Oxted, Surrey, whose main products, rectifiers and transformers, are complementary, are to be closely coordinated.

CABLE JOINTERS Limited and MALCOLM AND ALLAN (LONDON) Limited, both specialising in industrial electrical installation, are being brought under one management.

In the previous financial year Metal Industries acquired TOWLER BROTHERS (PATENTS) Limited, engineers concerned in the control of power by high pressure oil hydraulics, and also AVO Limited, and its subsidiary, TAYLOR ELECTRICAL INSTRUMENTS Limited, instrumentation engineers. All three are expanding their turnover and are engaged on new lines of development.

The group now has a programme of capital expenditure under way for the increasing efficiency of its production and for the expansion of its activities, more especially in the newer developments.

Reporting that the group's labour relations have been maintained at "their usual excellent level," the chairman gives an important part of the credit for this to *MI News*, the companies' readable house journal which during the year won an award of excellence in the British Association of Industrial Editors' national house journal competition.

Wheel and Axle Plant Going up at Durgapur

What is happening at Durgapur?

A recent progress report shows that the erection of structural steelwork and the civil engineering is now almost complete. The larger part of the site activity is now concerned with the erection of mechanical and electrical plant and equipment.

Some 95 per cent of the plant and equipment being supplied from the United Kingdom, about 243,000 tons, has been shipped. From the first shipment from Britain in February, 1957, the flow of refractory bricks, steelwork and equipment has gone on continuously, rising to 16,000 tons a month at the busiest period.

In the steel making plant's melting shop two out of the seven 200 ton open hearth furnaces are in production and a third furnace has been completed. The first of the two 800 ton capacity hot metal mixers is complete and the second is being bricked.

The wheel and axle plant is the last stage of the works, which are due to be completed by July next year. Most of the foundations for buildings and plant have been put in.

Training in Britain of 350 engineers for Durgapur's supervisory staff has been paid for by the UK Government, under the technical cooperation scheme of the Colombo Plan.

Food for a Maiden Voyage

Some idea of what it means to provision a modern luxury liner for a long voyage is given by this list of a few of the supplies that the 37,640 ton "Windsor Castle" took on board for her maiden voyage from Southampton to the Cape.

4,816 lb fresh butter, 50 hams, 3,000 lb of turkeys, 84 brace of fresh shot grouse from Scotland, 1,000 peaches, 680 lb of hothouse grapes, 12 cwt cauliflowers, 9 gallons cocktail onions, 12 lb sugarless jam (for diabetics), 112 lb fresh picked mushrooms, 37,000 new laid eggs, 1,200 lb pork sausages, 120 gallons fresh orange juice, 2,700 quarts ice-cream (8 flavours), 12,288 tubs of ice-cream, 14 tons potatoes, 800 sheep tongues, 160 ox tongues, 36 dozen ducks, 125 dozen chickens, 50 lb herring roes, 6 lb nursery rusks, 1,600 lb tea, 1,486 lb coffee, 1 ton 6 cwt small cube sugar, 140 gallons cooking and salad oil, 520 boxes corn flakes, 1,400 lb asparagus, 144 lb honey in crocks, 36 lb preserved ginger in jars, 147 lb glace cherries, 360 lb Cape gooseberries, 1,800 lb biscuits (27 types), 1,228 lb marmalade (6 types).

1,848 lb Cheddar cheese, 72 Camembert cheeses, 70 lb Stilton, 16 types of other cheeses from Double Gloucester to Pastorella, 120 lb venison, 14 dozen cucumbers, 270 dozen lettuces, 2,400 lb dessert apples, 550 lb melons, 18,000 oranges,

Cheese Making Takes a Turn for the Better

A recently developed device reduces the man-hour requirement of cheese manufacture. It also improves the flexibility of the process and cuts down the risk of contamination.

UNTIL fifty years ago, cheese making was exclusively the province of the farmer's wife. Now, of course, it is done in a factory and chemical engineers are responsible for our cheese. The basic principles of manufacture have remained unchanged over the years nevertheless and, although some operations have been mechanised, the general trend has been merely to apply mechanical power to what were previously arduous manual operations.

Cheddar cheese is the most popular brand in this country, and in consequence it forms about 50 per cent of our cheese production and an even higher proportion of our imports.

In the manufacture of cheddar cheese, some 25 per cent of the total labour force occupy themselves in what is called "the cheddaring stage" of cheese manufacture. This involves running off the whey and milling the curd (whey is the thin stuff and curd the thick stuff when milk separates).

Before cheddaring can take place, the curd particles are allowed to settle in the bottom of a vat and the free whey which remains on top is run off. In the traditional method of cheddaring the resultant mass of curd is cut into small blocks which, at regular intervals over a period of between 1½ and 2 hours, are turned and stacked one on top of another into piles. During this process, considerable changes take place in the curd. Acidity develops, whey drains, the curd particles fuse into a continuous mass and the blocks of curd become deformed under the weight of those above and spread sideways.

The operations of turning and piling the curd are carried out by hand and involve the application of considerable physical effort. Mechanisation of the process was found to be far from straightforward, and thus it came to the notice of the National Institute for Research in Dairying (NIRD), who set themselves the following objectives:—

(1) Simplification of the cheddaring process,
(2) Reduction of the amount of effort involved, and
(3) Replacement of the existing batch process by a continuous one.

These objectives have been met by a simple piece of machinery developed by the NIRD.

THE NEW WAY

A diagram of the machine is shown in Fig. 1. A column of curd is contained within a tall vertical tube which is constructed with an increasing diameter from top to bottom. A steady supply of curds and whey is fed into the top of the tube keeping it full. Meanwhile the whey drains off through perforations in the wall of the tube and the curd remains to build up the column. Cutting blades situated at the bottom of the tube support the column and rotate, thus removing the curd at a fixed rate.

In this way, a continuously moving column of curd is produced and each particle of curd, as it travels through the tube, is subjected to increasing pressure from the weight of curd above it and is allowed to spread sideways because of the increasing diameter of the tube. The rate at which the curd travels down the column is such that acidity is given time to develop sufficiently. The cheddaring conditions are, therefore, fulfilled and the curd treated in this way is very similar to curd cheddared in the traditional manner. The method of removing curd from the column obviates the need for milling and the subsequent operations proceed as normally.

Cheddar cheese is usually graded when it is between four and six weeks old. Cheese processed by the new method is found to be completely satisfactory. When it is mature, that is when it is between four and six months old, it has the firm, rather wax-like body, the close texture and the flavour of a normal Cheddar.

The advantages of the system of continuous cheddaring which has been described are then as follows:—

(*a*) The machinery is simple, easy to construct, and comparatively inexpensive both to install and to operate,
(*b*) Any existing type of curd making equipment can be used, without modification, to prepare curd for the machine,
(*c*) The cheese making process is subject to greater control so that a more uniform product can be obtained,
(*d*) Because the process is carried out in a closed vessel, the risk of contamination from the air and from manual handling is obviated,
(*e*) The incorporation of a cutter for removing curd from the machine overcomes the need for a separate milling operation, and
(*f*) The physical effort involved in cheddaring, and therefore the labour requirement, has been reduced.

The present day cheese maker is faced with a number of problems which, either directly or indirectly, influence production. The amount of milk available for cheese making varies throughout the year according to seasonal variations in milk production, fluctuations in the demand for liquid milk and the changing needs of other milk product manufacturers. Cheese factories must then be organised to accept wide variations in daily throughput. Seasonal peaks force manufacturers to rely to some extent on casual labour which may well not have the necessary skill. Mechanisation has brought with it little extra control over the process which still remains subject to human error and inconstancy. Finally, the curd preparation part of the process is very susceptible to bacterial contamination.

These problems are concerned with various aspects of the labour requirements and they indicate ways in which the cheddaring machine could make a significant contribution to the process of cheese making. As well as the advantages already mentioned, the cheddaring machine cuts the man-hour requirement at the cheddaring stage to a quarter of its former value.

In addition, the machine can be arranged so that it gives the flexibility of throughput necessary for coping the fluctuations of supply and demand. Take, for example, a factory in which the curd is cheddared at a maximum rate of 6,000 lb per hr. Using the new method, this volume can be handled by one machine with a 6 ft long tube, a top diameter of 3 ft and a bottom diameter of about 7 ft. Alternatively, a number of smaller machines can be used—say six with a capacity of 1,000 lb per hour.

The latter, multiple machine, arrangement provides the flexibility required. This arrangement has another, somewhat surprising, advantage in that the capital cost of a number of smaller machines would probably be less than the cost of an equivalent capacity single machine, because a common cutting device could serve at least two or three of the tubes.

Fig. 1 How the cheddaring machine works.

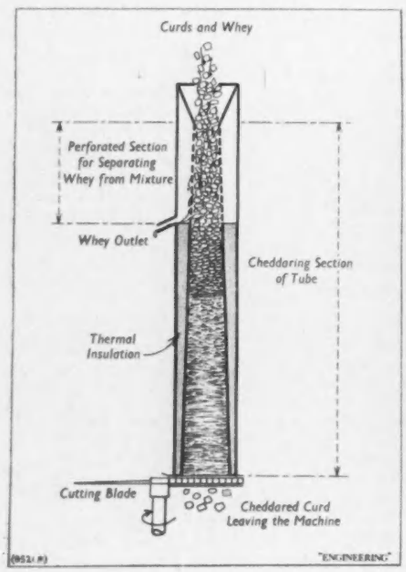


Fig. 2 The upper perforated section of the device.

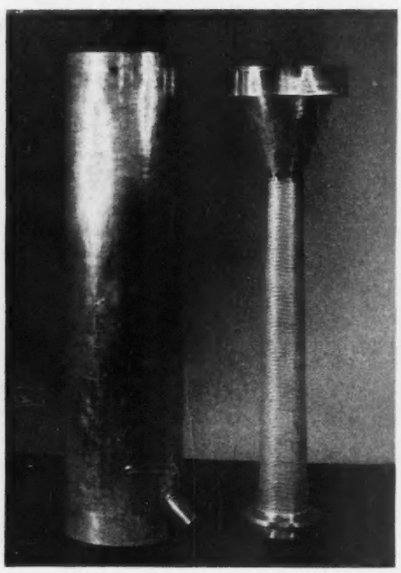
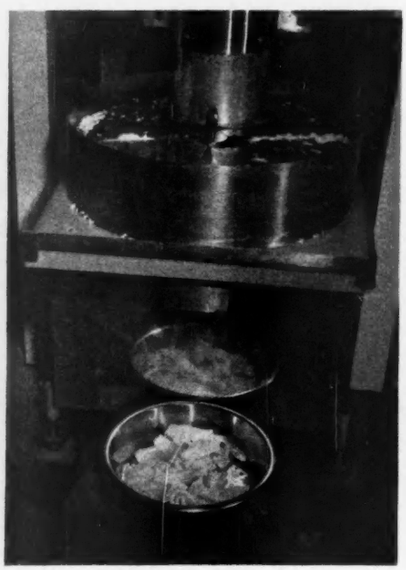


Fig. 3 Cheddared curd being removed.



(Left) The hydro-cooler, showing the mechanical lifter at the end of the tank.

(Right) Air velocity in the cold room is reduced to a minimum by installing two coolers across the width.

Hydro-Cooling for Watercress

Because of its highly perishable nature, watercress suffers more wastage during transit between grower and consumer than other leaf vegetables. This is particularly evident during the warmer months when the crop wilts and loses colour very readily indeed.

In order to reduce this wastage and to ensure the arrival of a fresher product at the market, increasing interest is being shown by growers in the possibilities of refrigeration and hydro-cooling.

One of the latest growers to employ hydro-cooling is Isaac Brothers of Alresford, Hampshire. The plant comprises a tank in which cooled water is circulated, equipment for lifting the cooled produce from the water, and a cold room for storage. It has been designed on the continuous flow principle, the various stages being linked by roller conveyors.

The watercress is picked and carried in baskets or tubs to the packing and process shed. This building is divided into four main sections. The unloading bay is at one end and the offices and stores are at the other, while the rest of the building is split down the middle, operators preparing watercress on one side and the cooling plant and cold store being situated on the other.

After it has been washed, trimmed, bunched and packed into chip baskets, the watercress is placed on an inclined conveyor which takes it through a trap hatch into the cooling section. Here, an operator places tops on the baskets and transfers them to a further conveyor along which they slide, under gravity, into the hydro-cocling section.

The hydro-cooler is an open top tank with a horizontal baffle which divides the tank in two. In the lower part of the tank, there are the coils of a York 1½ h.p. Refrigerant 12 condensing unit—cooling being by the "ice-bank" principle. Cooled water is pumped from the lower section and discharged through nozzles directly on to the baskets of watercress which float along the upper half of the tank. The water is returned for re-cooling through fine mesh screens to the bottom of the tank. Water loss is compensated for by a header tank mounted at one end of the hydro-cooler.

The baskets pass down the tank three abreast, guided by rails and propelled by water jets directed from behind. When they reach the end of the tank, they are lifted out by a power operated elevator, and mechanically assisted down a roller conveyor into the cold store.

In designing the cold store, consideration had to be given to the respiration of the watercress. Furthermore, since watercress will dehydrate rapidly, a high degree of humidity had to be maintained.

Although the room is not more than 900 cu. ft in capacity, two unit coolers were installed across the width of the room to reduce air velocity to a minimum. Standard York R5F ceiling mounted forced draught coolers were used, connected to a Yorkometic sealed condensing unit.

The cold store is insulated with 4 in of polystyrene on the walls and 4 in of cork on the floor. It is finished both internally and externally with galvanised steel sheet. Unloading takes place through a hatch to a vehicle outside, which carries the watercress to the station to be transported to markets throughout the country.

The advantages of hydro-cooling have already been proved by considerably increased demand from this grower. Apart from benefits to the distributor and consumer, certain economies are gained by the grower. The use of short term storage enables labour to be employed evenly during the week while heavy end of the week loads can still be handled with ease.

The plant was designed and installed by Scott and Scott (Bournemouth) Limited, in association with SCATS of Winchester, who were the main contractors for the construction of the packing station and other engineering services.

Continuous Brewing is on the Way

The traditional method of producing beer is a batch process with large volumes being mashed, boiled, fermented and algered in large batch vessels. However, as with other industries, the urgent need to reduce production and capital costs has led to considerable research being carried out into methods of continuous beer production.

Until recently, the most spectacular progress in the field of continuous brewing has been the work of New Zealand Breweries on continuous fermentation. The Morton-Coutts process, developed in New Zealand, has enabled beer to come under automatic control. This process is now so successfully developed that it operates 24 hours per day, seven days a week throughout the year with very little supervision. Already, this process is being successfully applied in other parts of the world, though it has yet to be proved entirely satisfactory on all types of beer.

More recently, experiments have taken place in Great Britain and Canada into methods of continuously mashing and boiling beer. The APV Company of Great Britain has developed a system of processing the wort at a high temperature and then passing it through hops in such a way that a continuous stream of fully processed and hopped beer can be fed into the fermenting stage. In this system, not only is there a considerable saving in capital cost and steam consumption, but also substantially increased extraction of hop flavours is achieved.

A rather different approach to continuous boiling has been developed at the Brewing Industries Research Foundation (BIRF) at South Nutfield, and it is anticipated that it will be the subject of further development by the British brewing industry in the near future.

At the beginning of the year, a plant, developed in conjunction with BIRF, was installed by APV at the Park Royal Brewery of Arthur Guinness, Son and Company Limited to experiment into methods of continuously mashing beer.

These experiments have made good progress and similar plants are now being installed in other breweries. Sufficient experience has already been gained on this process to show that there is promise of substantial saving in running costs, space and possibly raw material consumption. A system of continuously mixing, grinding and weighing grist has also been developed and this is coupled to the continuous mashing plant. It is now possible to install a continuous plant right through from the grain input to the fully fermented beer, at an output rate sufficient for a small town brewery, say 1,600 barrels per week, on one floor of a room sized about 70 ft by 20 ft (only the small grain handling section need occupy two storeys). It is now conceivable that small continuous brewing plants will be sited near the centres of beer distribution thus greatly reducing the cost of transport.

However, considerable work still has to be done on the remaining stages of beer production. Obviously a great deal will be gained by the shortening of the ageing and storage period for both British and Continental type beers. This stage of production occupies a disproportionate amount of space and leads to excessive capital and running costs. Processes have been developed, both to achieve rapid ageing and rapid clarification of fermented beer, but it cannot be said that any of these processes are yet fully proven.

It should not be long before beer will be brewed, fermented, matured, pasteurised and bottled inside a period of three days—as compared with the current period which varies from 6 to 14 weeks.

From Field to Frozen Food Cabinet

The virtues of quick freezing, as opposed to ordinary slow freezing, were established experimentally by Clarence Birdseye in the USA in the 1920's. It is some 30 years since he launched his first commercial product. In 1943 Unilever began to take up quick freezing, and formed a company in Britain to process foods under his name and patents. The company did not in fact start production till 1946. Then it took a small factory at Great Yarmouth, where it achieved a total output of 310 tons. Today Birds Eye Limited have five factories, a payroll of 8,000, and a capital of £10 million. The original 100 stockists have grown to 65,000 and new accounts are being opened at the rate of 1,500 a month.

Quick freezing makes it possible for the farmer to plan his activities with greater exactitude. Contracts are drawn up between growers and quick freezers well before the time arrives for the seed to be planted. Soils are tested for their suitability, seeds are prescribed by the company concerned, planting times are laid down, and when the crop is ripe the agricultural executive of the company gives the signal for harvesting to go ahead. Thus the farmer can give all his attention to the land and to producing the best possible crop, while production, storage, and marketing are left to the quick freezing company, whose requirements are known and whose ultimate market can be predicted beforehand.

The company's executive helps the grower throughout the life of the crops; he advises on cultivations, fertilisers, insecticides, etc. Then, in the last fortnight of the crop's growth he visits it daily, taking samples back to the factory for testing on a "tenderometer." The grower is given a bonus for tenderness to encourage him to cut the crop when it is at its best.

Since vegetables lose their freshness rapidly after harvesting, the company take steps to reduce the time interval between harvesting and freezing. Pea vines, for example, are delivered initially to vining stations where vining machines separate the peas from the pod and haulm. The waste material goes back to the farm for use as silage; the peas, in metal containers, are taken by lorry to the quick freezing factory.

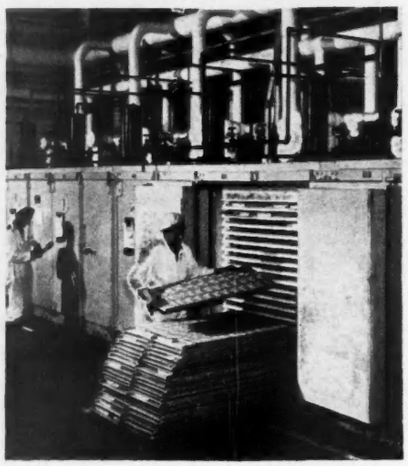
After peas, green beans probably represent the crop where most advances in handling operations have been made. Birds Eye bred a new variety which was not only "stringless" but grew at a uniform distance on the stem from the ground. In collaboration with manufacturers of agricultural machinery the company were then able to introduce a mechanical bean harvester with feeder forks at just the right height. This piece of equipment has not only eliminated the work of some 30 hand pickers, but has enabled several acres of green beans to be harvested—like peas—within a few hours, making large-scale cultivation of this crop an economic proposition for the first time.

Four hours is the maximum time between cutting and freezing peas. The number of processes in the factory is strictly limited so as to prevent over-handling of the product; included are air cleaning, washing, grading, and inspecting. One freezing method used is called "plate freezing," which involves placing the peas in their packets in machines with large double doors in which refrigerated metal plates are compressed hydraulically, so as to give an even spread of quick freezing. The products in their cartons are frozen right through to 0° F.

Today, Birds Eye have cold storage capacity operating at 0° F in excess of 23,000 tons of frozen foods. Of this cold storage space, the factory stores hold over 17,000 tons and the 43 regional distribution depots take about 6,000 tons. A further 19,000 tons is being added to the company's capacity this year. Space is also rented in public cold stores.

By the widespread use of mechanical handling, modern structural techniques, and palletisation, the company have brought down storage costs considerably in recent years. Nevertheless, the cost of efficient cold storage is still one of the biggest charges that the company has to bear.

Transport is carried out in two stages—from the factory to the regional cold store, and from the store to the retailer's cabinet. Delivery over the first stage is mosly by rail. Refrigerated containers jointly designed by Birds Eye and British Railways have cut transport costs per ton of frozen food and speeded loading and discharge. The majority of movements by such containers are completed within 24 hours of dispatch. There are nearly 100 refrigerated containers of this type in operation. Latest designs maintain their contents at 0° F for 24 hours in outside temperatures up to 80° F.



One method of quick-freezing is by plate froster. Here, at a Birds Eye factory, cartons of produce are loaded into the froster for quick-freezing.

Bulk delivery from factory to regional stores is also made by 14 ton refrigerated road vehicles. Like the rail containers, these vehicles maintain the products at 0° F in summer temperatures and are designed for palletised unloading and loading. Delivery to retailers from the stores is carried out by a fleet of insulated vehicles, most of which are mechanically refrigerated. The majority of these vehicles are of 2½ tons capacity but there are others designed for special duties. By the end of 1960 deliveries will be being made to 80,000 frozen food cabinets in retailers' shops.

Maintaining Deep Freeze on the Railways

Developments in the food industry have given rise to growing demands for insulated containers on the railways. A number of different types are now in service for these specialised traffics. The type AF highly insulated container, for example, is designed to carry up to 3 tons of ice cream and frozen foods and other goods. Insulation is by 9 in of expanded ebonite and refrigeration is obtained by the use of Dry-ice. Commodity temperatures as low as −15° F can be established over a 24 hour transit, but the more usual range is between 5° and 10° F.

The AF highly insulated container can carry 3 tons of ice cream or frozen foods.

The AFU container, similar to the AF, is equipped with eutectic plates. These, suspended from the ceiling, are frozen by connection with a firm's ammonia or Freon gas compressor before loading. Temperatures of −6° or −12° F can be maintained for 48 hours, a comfortable margin for the longest of journeys. About 180 AFUs are in service.

Special provision for the customer is made in the AFU pallet container. In it, ice cream in wire mesh pallets—four to a load—is conveyed. Loading and unloading is done by fork-lift truck through double doors at one end. Rollers fitted to the floor allow the pallets to be moved easily into position. Fifty-five of these units are under construction; several of another type suitable for palletised quick-frozen foods are also being built.

For the conveyance of Dry-ice at temperatures of −110° F, the AX container, with 10 in of insulation is provided. 300 are in service.

Interfrigo, the international railway-owned company which specialises in refrigerated transport of perishable foodstuffs, increased their traffic by over 32 per cent during the first five months of this year compared with the same period in 1959. Traffic has grown steadily with the progressive development of the company since its formation in 1949. Last year 84,000 wagon loads were carried. Of these, 4,700 wagon loads passed between the Continent and Great Britain, by way of British Railways' Dover-Dunkerque and Harwich-Zeebrugge train ferries.

Interfrigo operate partly with their own rolling stock and partly with wagons hired from member administrations or their subsidiaries. The first series of Interfrigo's own wagons, 525 in number, came into service in 1951-52. By the end of 1960 the total stock owned will be 1,700.

In fact, Interfrigo have great faith in the continued development of international perishable traffic by rail. Increased production of fruit and vegetables is taking place in all producer countries; the demand in consumer countries is increasing as a result of improving standards of living; and new markets are being opened up as a result of the better transport facilities available. In Italy, for example, it is expected that exports in 1964 will be 50 per cent up on those of 1954.

Techniques for Transporting Tender Fruits

A major industry in the Channel Islands is the production of tomatoes for delivery in Britain. Guernsey, for example, has the biggest concentration of glass houses in Europe, covering nearly 1,130 acres. (By way of contrast, most Jersey tomatoes are grown in the open.) The shipping season lasts from April to the end of August, and carriage is by cargo vessels operated by British Railways.

To cope with Channel Island traffic throughout the year, British Railways operate a fleet of five cargo vessels. Sambur and Roebuck are twin-screw steamers of about 860 gross tons each, built in 1925, with cargo capacities of nearly 500 tons. Winchester—the largest—is also twin-screw but diesel powered, and with a gross tonnage of 1,150 tons has a cargo capacity of 650 tons. She was built in 1947. Elk and Moose entered service last year and have their machinery aft; they have a gross tonnage of just under 800 tons. During the summer season other vessels are chartered as necessary—in the height of summer as many as four cargo ships sail from Guernsey in a day.

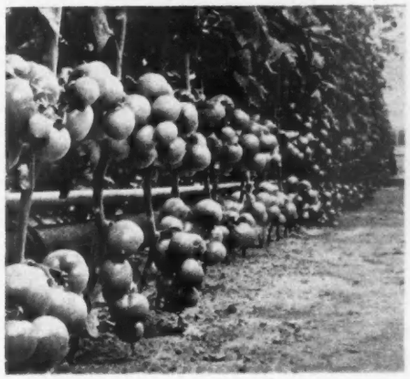
Tomatoes are packed in " chips "—chipboard containers weighing 2 lb that hold 12 lb of tomatoes. In the past the chips have been placed directly in the ships' holds, being loaded and discharged on scale-boards. Now increasing use is being made of three-sided wooden cribs into which the chips are packed. These not only make bulk handling easier but also offer additional protection to the tomatoes. Mechanical handling devices—power trolleys in the holds and fork-lift trucks and other powered vehicles on the quay—have been employed for some time, and their success is leading to a further extension of their use. As a result of experimental operations last year, palletisation will be extended, using stackable metal pallets which save space on the return journey. Experiments have also been carried out with dutch trays—flat load-carrying platforms with supports at each corner for stacking.

What the final arrangement of packing will be is not clear yet. The problem is more involved than it appears at first sight. Complete palletisation, for example, would reduce the cargo capacity of the ships by up to 30 per cent, the equivalent of an additional daily sailing during the peak period. At present both British Railways and the Guernsey authority are examining ways to improve packing and handling which offer savings in time and labour.

Up to last year, one sailing in three was destined for Southampton. However, in this busy port dealing with world traffic, labour is not always available to unload the tomatoes, which have to be dispatched quickly. In the past, Southampton-bound ships have been diverted to Weymouth and rapid progress has been made in improving the quayside facilities at this port—from this year Weymouth will normally handle the whole of the Channel Islands perishable produce.

The dispersal of the long lines of little baskets that quickly rise on the quayside as the ships unload has to be planned carefully in advance. Well before the arrival of the first shipment, joint discussions are held between the Railways and the representatives of the Guernsey Tomato Marketing Board. The previous year's arrangements are examined for weaknesses and the size of the new season's crop is estimated. Proposals for better services to a larger number of markets are made as railway modernisation extends the range of next-morning delivery. Arising from this meeting, a timetable of special express freight trains is scheduled.

The Board wants the tomatoes delivered at the country's principal markets before 6 a.m. on the day following dispatch from Weymouth.



The present system of bulk dispatch, instead of individually addressed consignments, makes it possible to send off the earlier shipments to the farthest destinations. Thus, the 9.55 a.m., for example, takes tomatoes to Yorkshire, the North-East, and Scotland—providing next-day market arrival at such places as Bradford, Darlington, Halifax, Leeds, Middlesbrough, Newcastle, Sheffield and York. Edinburgh is reached later that day, while Aberdeen, Dundee and Glasgow receive their tomatoes on the second day. Later trains run to the Midlands and North-West, South Wales and London.

The special trains are fully braked and run as top-class express freight trains. They convey from 10 to 45 wagons, according to requirements. On " heavy " days many of them are duplicated. In 1959 more than 500 such trains carried away the bulk of tomatoes landed at Weymouth and Southampton.

Operating Transport and Tractors in a Water Company

The diesel versus petrol argument cropped up again at a meeting of the Institution of Water Engineers. Reading a paper, " Recent Developments and Current Practice in a Distribution Department," Mr. C. A. Serpell of the Sunderland and South Shields Water Company told how for general purposes the petrol-driven 5 ton drop-side hydraulic tipping lorries had been found most suitable for his company's work. The lorries run an average mileage of 12,000 a year, and the current average running cost, including standing charges and depreciation but excluding driver's time, is 10*d* a mile. A diesel lorry was acquired partly with a view to gaining operating experience, but Custom and Excise requirements give rise to fuelling difficulties with this vehicle. In addition, its running costs were found to be slightly more than those of petrol-driven lorries and it appeared to have no particular advantage over them.

Mr. R. W. G. Clerke commented on the author's remarks in the discussion which followed the paper, pointing out that in Manchester the water company had carried out tests with both types of fuel and had now standardised on diesel equipment. Their 3 ton tipping lorries running on petrol averaged apout 10 miles to the gallon over 19,000 miles a year, whereas the diesel vehicle averaged 19 miles to the gallon over some 22,000 miles a year. They were satisfied with diesel and did not find Customs and Excise requirements too difficult.

Mr. J. W. Seddon, too, took issue with the author with regard to his views on transport. In his experience at Cardiff the fuel consumption of a diesel-driven lorry was approximately 50 per cent of that of a similar petrol-engined vehicle and, on today's prices, that represented a saving of at least 2*d* per mile, that is £100 per annum per vehicle. A further advantage was the diesel's capacity to run for much longer periods between overhauls. Mr. A. C. Wildsmith pointed out that his board too found the operation of diesel transport cheaper than petrol vehicles, even though the board's fleet was too small to merit the bulk purchase of diesel fuel. The vehicles were fuelled on an agency card system, and the rebate was very small. Diesel fuel was 8½*d* a gallon more than petrol, but even so the running costs were lower taking into account all the various expenses.

In reply, Mr. Serpell agreed that on running costs alone the diesel lorry was cheaper, but held that when repair costs and depreciation were included, the diesel lorry was shown to be at a slight disadvantage compared with the petrol lorries. The difference in first cost between the diesel and petrol vehicles concerned, however, was now much less than when the company's diesel lorry was purchased, and when this factor, coupled with the bulk purchase of diesel fuel, was taken into account, it might well be that the diesel vehicle would show advantage.

Other points of interest in the operating experience of the Sunderland and South Shields Water Company were the facts that the 2 to 3 ton lorries owned by the company cost very little less to run than the 5 ton lorries, and the average running costs of their 15 cwt vans worked out at 4·7*d* per mile compared with 4*d* per mile for their 5 cwt vehicles. And the 15 cwt vans seemed the most satisfactory form of light distribution transport, although they were quite often larger than required for the particular purpose in hand.

Mr. Serpell also pointed out that since the company purchased its first tractor-driven hydraulic excavator in early 1956, this type of machine had undergone considerable development and had become a highly versatile and successful item of plant, invaluable both for distribution mainlaying and for mains repairs. He warned though, that because of their speed and economy in man-power, there was always the temptation to use these machines to the maximum possible extent, even to the point where other underground services were endangered. Even though it is argued that in many instances it is more economic to sweep away and subsequently repair existing services than it is to excavate round them by hand, the argument ignores not only the effect on relations between the public and the water undertaking, but also the effect on the relations between the " injured " undertaking and its consumers.

On a recent occasion, one of the company's excavators damaged a high-tension cable which was incorrectly marked on the available drawings. The incident caused an interruption of power supply to a number of factories which have subsequently claimed against the water undertaking for the consequent loss of production.

Mr. Serpell considered that to prohibit entirely the use of excavators in town areas would place on consumers an unwarranted burden in the form of increased costs in capital works. It was nevertheless necessary to establish some understanding whereby the risk could be reduced to reasonable proportions. Much is done by prior consultation with the authorities concerned, but precise information on the location of underground services is not always available.

On the Shelf

By Frank H. Smith

I take a poor view of not being able to notice a publication until it has reached No. 2 of Vol. 1. But I'll do my best with *Russian Technical Literature* from the European Productivity Agency (OEEEC) at 3 rue André Pascal, Paris. It is "a bulletin aiming to create interest in the use of Russian and other Eastern scientific and technical publications." This strikes me as being the coals to Newcastle equivalent of flogging dead horses, if you see what I mean. The interest is already there. What this bulletin actually does is, I gather, to keep one abreast in translation strides. (Am I getting a little involved?)

A good friend of mine (and anybody who helps me fill this column is a good friend of mine), the librarian of the Bristol University Engineering Laboratories, has called my attention to a "Bibliography of Theses written for Advanced Degrees in Geology . . . through 1957," by Chronic and Chronic. As he says, this is about the best since a book on maths. by Dull and Dull. He further qualifies for the Grand Order of Advisers to The Shelf (GOATS) by suggesting it is time that Read and Wright (and I know them both) should do a book on librarianship.

An article that might affect many of us appears in the *Unesco Bulletin for Libraries* for July/August. It is "International Library Loan Service of the USSR Lenin State Library" by the head of the Internal and International Loan Department of the Lenin State Library. Anybody who has dealings with these Russian state libraries knows that they are on the ball. I only wish they would use some sort of alphabet or language that I can understand in their correspondence (like one-syllable English).

You just don't know where you are these days. There it was, *The Aluminium Courier*, No. 49, and I knew darned well I knew the title but certainly not the format. Then I took the trouble to read the bit of paper that slipped out. They've changed the format. They're charging 2*s* 6*d* but it's still from the Aluminium Development Association, 33 Grosvenor Street, London, W1.

Professional writers should be the last people whom one can accuse of ambiguity (I am *not* a real professional writer) yet the International Society of Aviation Writers (25 Farmcote Road, Don Mills, Ontario) issues the *ISAW* 1960 *World Directory of Aviation Communications* and it is *not* a directory of airways. It *is* one of the worst arranged directories I have seen for a long time.

Chapman and Hall have a few lists available of their own and the Houses in America for whom they act's (is that the place for the apostrophe?) lists covering 1 July to 30 September (37 Essex Street, WC2, as usual). They (C. and H.) also have another title in the AEI Advanced Engineering Textbooks series. H. de B. Knight has done *The Arc Discharge* at three guineas.

The Library Association has sponsored a "Library Telex Directory" listing libraries with access to the system. This directory is not on sale but copies have been sent to public and special libraries (not to mine, however) to stimulate interest in the use of Telex for interlibrary use. And if I get a copy as a result of this I'll know this column is of some use.

For some months now, *The Times* has been spelling tyre (which they used, rightly, to spell tire) tyre. If this rot has well and truly set in it will not be long before they start on connection in place of connexion and dropping the formal Mr. and Miss (respectively, of course) in front of the names of actors and actresses. It will then be time for me to change to some other, less controversial, paper. But I shall miss those headlines on the Law Reports.

How Frequent are Floods?

Symposium on Spillway Capacity of Dams. Publication No. 65. *Central Board of Irrigation and Power, New Delhi, India.* (*Rs.* 10)

A unified approach to the estimation of flood discharges as a basis for designing the spillway capacity of dams has long been wanted. To meet this need India's Central Board of Irrigation organised a symposium, which was held in two parts during its annual research sessions in July, 1955, and July, 1956.

Various authorities throughout India were invited to contribute and sixteen papers covering different aspects of the flood problem were presented. The subjects discussed included (1) empirical flood formulae, (2) statistical analysis of floods and storms, (3) rainfall-runoff relationships, (4) the unit hydrograph method of deriving the flood hydrograph from the rainfall, and (5) flood routing.

Many of the papers are voluminous with one mammoth contribution occupying about one-third of the published proceedings and comprising 115 pages. The papers deal mainly with the application of known methods of analysis to particular catchments. There is little that is new and much that is repetitive. Considerable space is given to the enumeration and use of flood formulae, which are applicable in some cases to particular regions of India. There is a certain inconsistency here, for in almost every case where such formulae are quoted the use of a flood frequency analysis is prevented by the lack of data.

In general, recourse is made to rainfall records to determine flood discharges using the unit hydrograph technique. While it is not yet possible to calculate the response of a given catchment to a storm, *ab initio*, the unit hydrograph method enables the shape of the discharge curve to be built up for a given storm by analysis of hydrographs from isolated storms in the past.

Although the method is not exact, the errors are much smaller than those likely to be made in the prediction of the most severe storm likely to be encountered in the life of the structure. Such estimates require a statistical analysis of rainfall records to decide not only the intensity, duration and extent of storms which have occurred in the past, but also the probability of more violent storms in the future.

The statistical treatment most commonly used is that proposed by Gumbel, in which the characteristic shape of the probability distribution is assumed to conform with a theoretical distribution for extreme values. In the limit, such a theoretical distribution cannot be valid because there is a physical limit to the rainfall which can occur over any drainage basin and is determined by the meteorological conditions.

The application of the Gumbel method to the frequency analysis of rainfall data has been illustrated in great detail in several of the papers. Less attention has been given to the problem of relating the flood recurrence period so found, to the economics of flood control as a whole. Thus even though the total damage from a large flood may be great, protection against such floods may be uneconomical because of the large investment and infrequent flood occurrence.

A study of this aspect of the subject might have gone far to answer one of the questions which inspired the symposium, namely: what should be the frequency of the design flood adopted for a particular project? In the last analysis, this is not a technical question.

G. H. LEAN

Aperitif and Entrée

The Book of Experiments. By LEONARD DE VRIES. John Murray. (15*s*)

In these days we cannot afford to let a single potential scientist or engineer go unrecognised. This would not happen if all schools were as they should be, in regard to both staff and equipment. But it can happen if the science master is dull and lazy, and the history master keen and imaginative. It is unlikely to happen if the precious spark which we seek has already been kindled before the owner receives his formal initiation into science. If it has he will realise, for example, that the clean, dry specific gravity bottle, is by no means a fair sample of what physics holds in store.

It is difficult to imagine a better spark-kindler than this book. It describes one hundred and fifty experiments in physics and chemistry, but mainly physics, that can be performed in the home, mostly with homely apparatus and materials.

The experimenters envisaged are probably somewhere between five and fifteen years of age, but parents, uncles, teachers and some university lecturers could well derive entertainment and instruction from many of the experiments described. It is to be hoped, however, that they will be content to provide an audience, if children are available as demonstrators, since the whole idea of the book is that children should do the experiments themselves. There are several reasons why this is an excellent idea. Not only does it introduce them to the satisfaction of making things, and of making things work, but it is bound to stimulate their curiosity as to why things happen. This may be partially satisfied by the explanations given in the book, but for most children these will surely be the stimulus to further questions, and even further experiments.

The directions and explanations strike just the right note—clear and simple, but not condescending, humorous but not facetious—and the illustrations are an entertainment in themselves. The price is reasonable also, at a fraction over a penny per experiment. The book was first published in 1958, but deserves to be better known. Indeed, if the Government is really in earnest in wanting a greatly increased number of scientists and engineers it might well consider putting this volume into the hands of every child of ten.

Imperial College Inaugural Lectures, 1956-57 and 1957-58. *Imperial College of Science and Technology.* (*For private circulation, but individual lectures may be purchased.*)

The practice of requiring a new professor to "lecture himself in," so to speak, while not universal, seems to be increasing. Whether he approves of it or not, one may at least feel pretty sure that he will be at some pains to put up a good show. Moreover, whether he elects to describe his own research work, or to give a general survey of his subject, or to outline his departmental plans or policy, he will be conscious of the fact that he is addressing a very mixed audience, and is therefore largely debarred from using the technical language peculiar to his subject. If his presentation succeeds in overcoming this handicap and is also intelligible to the non-specialist listener, he has made a creditable contribution towards establishing communication, which steadily grows more difficult, between specialists in different fields.

This volume, which contains nine inaugural lectures on various branches of pure and applied science, poses two problems to the reviewer. First, the heterogeneous nature of the contents means that he cannot survey the book as a whole, whereas if he attempts a comparative appraisal of the lectures it is certain to be prejudiced by the limitations of his own knowledge and tastes. Second, although most of the lectures can be purchased separately, the volume itself is not on

sale. Nevertheless, the "friends of the College," to whom the volume has been presented, may include many universities, in which case it will be readily available to academic readers. It is possible, therefore, that a few comments will not be entirely pointless.

The lectures under review fall more or less definitely into one or other of the three categories mentioned, namely, personal research, general survey or departmental policy. The standard of exposition suggests that the new professors should worthily maintain the reputation of Imperial College; and if the standards of interest and intelligibility vary appreciably it is no more than is to be expected because of the diverse nature of the subjects. Professor Hayman, for example, makes a valiant effort to convey the fascination which study and research in pure mathematics has for its devotees, but it is unlikely that anyone but a mathematician will be able to follow him all the way. Professor Richardson, on the other hand, is on a much easier wicket when he discourses on extraction metallurgy. Again, Professor Salam is hard put to it to make recognisable sense of our present knowledge of elementary particles, whereas Professor Kay has relatively little difficulty in explaining the work and problems of the nuclear engineer. Of the remaining five lectures, two are in a sense complementary to two of those already mentioned. (Ball on metallurgy, Butler on nuclear physics), and two are on aspects of chemistry (Barton, organic and Duekwerts, engineering). Finally, Professor Peters, as the sole representative of biology and the occupant of a new chair of parasitology, presents his ideas of how the subject should be, and presumably will be, studied at Imperial College.

A miscellaneous assortment, to be sure, but undoubtedly worthy of preservation, and of a wider circle of readers than it is likely to reach.

W. E. CURTIS

The Spectrum of Flame Research

Flames: Their Structure, Radiation and Temperature. By A. G. GAYDON and H. G. WOLFHARD. 2nd edition. *Chapman and Hall.* (70*s*)

The study of flames can be regarded as a spectrum stretching from the ultra violet of fundamental applied science (physics, chemistry and mathematics) to the infra red of crude *ad hoc* changes in industrial flames to give day-to-day improvements. Just as in the spectrum it is difficult to distinguish sharply between one colour and another, so it is difficult to draw the line between fundamental applied science and engineering, but it is useful to consider what are the primary colours of this spectrum and how far Gaydon and Wolfhard's book ranges over the spectrum.

It is not of course necessary to regard the change in wavelength of the spectrum as coinciding with the change in size of the flame studied, because it is possible to carry out completely fundamental studies on full-size flames and equally possible to carry out *ad hoc* practical alterations on miniature flames to be used for industrial or domestic purposes. But there has certainly been a great tendency for the more fundamental experimental work to be carried out on laboratory-scale flames, and of course particularly the bunsen burner, and more recently the Egerton flat flame, which is very suitable for the study of laminar premixed flames. The Egerton flame is especially useful in studying the velocity of flame propagation. Gaydon and Wolfhard's work has also been carried out mostly on the small-scale laboratory flame, and particularly on those flames which can be operated within a glass chamber at variable pressures from atmospheric down to almost complete vacuum.

On the whole, the more practical large flames used in industry tend to be turbulent non-premixed diffusion flames because it is so often desirable to preheat the combustion air, while the laboratory flames that have been mostly studied have been premixed. In particular the velocity of flame propagation in a premixed system and the limits of inflammability provided the classical experimental studies.

We can call the blue end of the spectrum the physical chemistry of combustion reactions, the study of chain reactions, intermediate radicals activation energies and kinetics of reactions. Experimental techniques have involved mainly the glass apparatus of the laboratory, and the use of spectroscopy and methods for observing radicals in flames. On the whole the physical chemists have interested themselves more in cool flames below 1,000° C, while the reactions of interest in practical flames are always at temperatures more in the region of 1,500° C.

Coming to the green of the spectrum, we have laboratory work on diffusion flames and on the diffusion process, and the measurements of burning velocity on premixed flames. These are already much more complicated than the straightforward physical chemistry.

The laboratory measurement of flame temperatures and overall heat transfer by radiation from miniature flames, laboratory studies on unstable and oscillating flames, and the effect of sound on flames also come in at this stage. The same category includes combustion studies of individual drops of pure hydrocarbons and individual particles of pure carbon, and of the mechanism of combustion for a solid propellent in a rocket. At this stage it is still possible to attempt to solve the fundamental differential equations for the processes going on, although these differential equations always involve simultaneous diffusion and chemical reaction.

The yellow colour in the spectrum of flame studies can be regarded as the use of special items of equipment which are not in any way geometrically similar to practical flames, but which subject the fuel to a similar history as regards temperature and mixing with oxidant to that which it will receive on the average in a practical combustion system. In this category comes the Longwell reactor for the study of homogeneous systems, where the fuel and oxidant are premixed and fully mixed with the reaction products, and the controlled mixing history one-dimensional plug flow flame, which has been developed at Sheffield University and which is being used on coal, hydrocarbon vapours and hydrocarbon drops.

The orange of the spectrum corresponds to the construction of special furnaces and combustion chambers for the study of flames which are geometrically similar to those in practical combustion systems, that is to say, the fuel has a different history across the system, according to whether it flows on the axis or near the edge of the flame. These flames are thus essentially two-dimensional, and the Ijmuiden combustion tunnel and other tunnels built on a smaller scale at universities may be included here.

Finally, the red is the actual flame heating a combustion chamber in industry or in the domestic heating field. This has links with all the others and it is frequently necessary to carry out research on such a system by putting probes into it and evaluating the temperatures and soot formation, degree of combustion and mixing conditions. This gives the history of different parts of the fuel, thus relating it back to the orange and yellow, and even further back.

Gaydon and Wolfhard's book is a good attempt to concentrate entirely on the blue and green aspects of this spectrum, that is to say, the fundamental applied science of flames. It is a second edition and certain chapters have been entirely rewritten and revised and extended, particularly the section on carbon formation both in diffusion and premixed flames, and the section on ionisation in flames. A small point of criticism is that a chapter headed "Solid Carbon in Flames" might be regarded as dealing with the combustion of pulverised coal, whereas in fact it is concerned with the formation of carbon in flames from hydrocarbons.

The book can be highly recommended as a readable and clear account, perfectly intelligible to an engineer, of the more fundamental aspects of flame study.

M. W. THRING

Quantitive Basis

Theory and Application of Mechanical Engineering Measurements. By MARK B. MOORE. *Van Nostrand, New York and London.* (51*s*)

Modern developments have placed at the disposal of mechanical engineers a wide variety of advanced measuring techniques. Conventional courses in engineering rarely include adequate training in instrumentation and this omission results in a serious gap in the knowledge of many engineers engaged in the testing and experimental investigation of engineering materials and machines. Any attempt to remedy this deficiency is therefore to be welcomed. Unfortunately, this book does not go far to meet the need, at least where this country is concerned.

The author, a professor of mechanical engineering at Rutgers University, New Jersey, has written the book as a guide to experimental work for undergraduate students in mechanical engineering.

The book is introduced by a brief discussion of the fundamental problems of measurement and experimental errors. An account is then given of the methods and instruments for the measurement of various physical qualities of importance in mechanical engineering. The field of measurements surveyed is wide, ranging from micrometers and calipers to gas analysis and the detection of radiation. Many measurement techniques are given for each quantity and though there are important omissions, the book makes evident the wide scope of the subject.

Throughout, however, the treatment is very elementary and superficial, important instruments and principles are dismissed with a mere mention. The discussion of theory and principles is much simplified and in many cases deals with material which the British undergraduate will have been taught at school, and moreover, taught in a more precise and rigorous manner.

Later in the book the author deals with the organisation of tests and the preparation of reports. Here his views and methods are of some interest to teachers of engineering, though their usefulness to the student is limited.

In conclusion, detailed examples are given of

Continued on next page

some tests on specific machines and a very brief survey of a range of mechanical apparatus, mostly engines, and allied equipment. As these are well treated in literature, the value of the short account given here seems doubtful.

In criticising the faults of this book, one must bear in mind the difficulties of covering satisfactorily and fully a subject as varied and complex as mechanical-engineering measurement. It is to be hoped that these will not deter authors from attempting to provide the comprehensive surveys of the field which are needed by both students and practising engineers.

L. FINKELSTEIN

Hydraulic Servos for Fast Response

Fluid Power Control. Edited by JOHN F. BLACKBURN, GERHARD REETHOF and J. LOWEN SHEARER. *The Technology Press of M.I.T. and Wiley, New York; Chapman and Hall, London.* (140*s*)

The Massachusetts Institute of Technology has long been a fountainhead of wisdom on the subject of servomechanism techniques. Shortly after the Second World War, there appeared the famous *Radiation Laboratory* series, which included the still unsurpassed *Theory of Servomechanisms*, by James Nichols and Phillips. A little later, the formation of the Dynamic Analysis and Control Laboratory led to an extensive programme of research into hydraulic, and later pneumatic, servos. The essential results of this work have been presented to the public in the last nine years or so in the form of a number of papers, which the wise practitioner in fluid pressure servos has assiduously collected, and which together form a thoroughly comprehensive and rational basis for design work.

To a large extent, the most valuable portions of *Fluid Power Control* are those which repeat this material in book form, though much rewritten and augmented. In particular, the reader will find in the book a lucid and comprehensive analysis of the flow characteristics of hydraulic and pneumatic valves, of the forces acting on them (friction, Bernoulli and transient forces on slide valves, and forces on flapper valves), and of methods of force compensation. The chapter entitled " Valve Configurations and Construction " also includes much practical advice (sometimes given in an engagingly avuncular manner) on precision manufacturing techniques, valve materials, and sundry practical problems. There is also a useful chapter on " Electric Actuators " (known to most of us as " torque motors "). All this material is preceded by two chapters dealing respectively with the properties of fluids and the fundamentals of fluid-flow theory.

This portion of the book is altogether excellent, and incidentally—for the most part—extremely well written. With such wisdom to guide him, even a relative novice in the art need not go far wrong (in the end, of course, we must all learn the hard way, but good counsel does make the road shorter.)

The early chapters also include one on displacement pumps, most of which is devoted to an exposition of Wilson's rotary pump theory, and to the thermal wedge effect. All useful material, no doubt, but perhaps a little out of place in its context. A chapter entitled " Electro-Hydraulic Actuation " in effect deals with two-stage valves, but unfortunately forgoes any extensive general discussion of this very important topic in favour of very detailed treatment of one particular design.

The second half of the book deals with systems as opposed to components. The chapter on dynamic performance analysis presents, within some 60 pages, the essentials of servomechanism theory. The result is disappointing, the exposition being inferior to that already available from the better textbooks on servo theory, while even the choice of topics is questionable. Thus care is taken to expound all the major methods of stability analysis—Routh's criterion,' Nyquist diagrams, Bode plots, root locus plots—but nothing is said on the vital subject of compensating networks or other methods of performance improvement.

The chapters entitled " Hydraulic Drives " and " Pneumatic Drives " are mostly devoted to deriving the equations for the classical open-loop fluid pressure controls. Somewhat surprisingly, these equations are not exploited in the next chapter, entitled " Closed Loop Systems," which repeats much of the same analysis from the beginning, and altogether does the subject rather less than justice. This sort of thing has been done better before, particularly in a paper by Harpur, quoted in the book (N. F. Harpur: " Some Design Considerations of Hydraulic Servos of the Jack Type," I.Mech.E. Conference on Hydraulic Servomechanisms, 1953). The remainder of the same chapter is devoted to analyses of two types of automatic valve in relation to systems controlled by them; useful perhaps as examples of dynamic analysis applied to fluid pressure systems, but really too specialised in their context. The same criticism could be applied to the next chapter, which concerns power steering.

The penultimate chapter is devoted to a comparison of hydraulic and pneumatic servomechanisms, based on a quantitative analysis for a given performance specification. The conclusion is interesting: " thus the hydraulic system is about 50 times as fast as the pneumatic for the same load mass and supply pressure." The choice of equal supply pressures as a basis of comparison is no doubt justified if the space available for the actuating cylinder is a limiting factor. In other cases, some other basis might be fairer, and it is interesting to speculate whether the discrepancy might then be reduced.

Altogether, the second half of the book does not measure up to the first, and has a somewhat disjointed character. But a book such as this is not to be treated as if it were " of one piece." It is very well worth having for such first class material as it contains, and that cannot be praised too highly.

R. HADEKEL

New Books

Ballistic and Guided Missiles. By ADRIAN BALL. The Mechanical Age Library. *Frederick Muller.* (9*s* 6*d*)

A simple yet detailed description intended for young people, illustrated with photographs and outline diagrams.

Ordinary Differential Equations and their Solutions. By GEORGE M. MURPHY. *Van Nostrand Company, Princeton, New Jersey, and London.* (64*s*)

For the first time in English, this comprehensive reference book presents a compendium of methods for solving ordinary differential equations, supplemented by a tabulation of some 2,000 differential equations and their solutions.

Radioisotopes: A New Tool for Industry. By SIDNEY JEFFERSON. 2nd edition. *George Newnes.* (21*s*)

The new edition of this business man's guide to isotopes includes additional chapters on liquid flow measurement, mechanical and geological applications, direct production of electricity from radiation, luminescent materials, and gamma radiation processing.

The Register of the Gas Industry, 1960. *Gas Publications Ltd., 157 Hagden Lane, Watford, Herts.* (25*s*)

Details of undertakings and their officers in Great Britain and the Commonwealth, together with an index of officials, are followed by reviews on carbonisation, refractories, oil gasification, by-products and plant.

High Voltage Direct Current Power Transmission. By COLIN ADAMSON and N. G. HINGORANI. *Garraway Ltd., 11 Kensington Church Street, London, W8.* (84*s*)

The authors are closely associated with the only laboratory outside Sweden and the USSR devoted to large scale research and development in hvdc, and have produced a comprehensive text in their field, drawing on both their own practical experience and a very wide study of the literature.

Mineral Use Guide, or Robertson's Spiders' Webs. By R. H. S. ROBERTSON. *Cleaver-Hume Press.* (21*s*)

32 " spider's web " diagrams show the main uses of 52 rocks and minerals. The second ring of the diagram usually gives the form of processing employed, and the outer ring the applications, but the scheme is varied to fit the various minerals.

Coordinate Geometry. By LUTHER PFAHLER EISENHART. *Dover Publications, New York; Constable, London.* (13*s* 6*d*)

A facsimile reprint of the 1939 edition. The author had tested his text on freshman courses at Princeton University, where he held the chair of mathematics.

The Reviewers

Mr. G. H. Lean is principal scientific officer at the Hydraulics Research Station, Wallingford. He holds a B.Sc. in physics and a D.I.C. in aeronautics.

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Mr. R. Hadekel, B.Sc. (Eng.), A.C.G.I., D.I.C., M.I.Mech.E., A.F.R.Ae.S., is engineering consultant responsible for various projects, mainly in the field of automatic flight control, with the Sperry Gyroscope Company, Limited. He is author of *Displacement Pumps and Motors* and *Hydraulic Systems and Equipment.*

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Steel Castings. BROWN, LENOX AND CO. LTD., Pontypridd, Glamorgan. Useful reference source for users of steel castings. To British Standards. Glossary of terms needed for talking shop. 26 pp., ill.

Glass Making. MORGAN CRUCIBLE CO. LTD., Battersea Church Road, London, SW11. Sizes of carbon socket formers and cone forming dies. 1p., ill.

Refractories. MORGAN CRUCIBLE CO. LTD., Battersea Church Road, London, SW11. Introducing the range of Tri-Mor mouldable and castable refractories. Complete property data. 9 pp., ill.

Chromate Treatments. PYRENE CO. LTD., Great West Road, Brentford, Middx. New Bonderizing treatments for aluminium. 3 pp., ill.

Hardenability of Carburised Steels. CLIMAX MOLYBDENUM CO. OF EUROPE LTD., Cavendish Place, London, W1. Core hardenability in accordance with ASTM A255-48T. Case hardenability from direct quenched Jominy bars, some tempered. Steels mostly to AISI specifications. In atlas form. 136 pp., ill.

Marketing

Malta Making A New Life

NINE British firms are going ahead with their plans to set up in Malta.

This is only five months from the start in London of the campaign to attract industries to the well placed little island from which the Royal Navy were departing. Since then United Kingdom firms have put up 300 inquiries. In addition to the nine definitely going ahead, there are eleven applications at present making their way through the Maltese Aids to Industries Board.

The special inducements which are being offered include grants, tax concessions and new factories at low rents. Rather more important in the long term are the factors of ready availability of trained, or trainable labour, and Malta's splendid position, on a main trade route close to Mediterranean, North African and Middle East markets.

Two of the first nine firms will be a car assembly plant, employing 250 people, and an integrated cotton mill with work for 500. Among the eleven applications in the pipeline are schemes to expand a successful plant propagation business to Malta, and for the production of clothing, knitwear and plastics.

Farm Machinery Better Abroad than at Home

Has the heavily mechanised British agricultural market reached saturation point?

The decline that has been going on this year in the sale of agricultural machines suggests that this may be so. Currently the Agricultural Engineers' Association reports that there was a 14 per cent decline in the first half of this year over last year's home sales of farm tractors and machinery.

The sales of combine harvesters are not much above half of last year's in the same period.

The export performance of the industry is a powerful compensation to the sad home picture, but it indicates a significant change. There has been a comparative slackening in the pace of agricultural machinery sales to the Commonwealth, the increase on last year is 3 per cent. The overall increase in farm machinery exports has been 10 per cent.

Despite growing German competition some useful increases in sales to European and other countries outside the Commonwealth have been made.

Pyrene to Expand Bumper Production

Considerably increased output of bumpers for cars and commercial vehicles is planned by the PYRENE Company. From the Ministry of Aviation the company have taken over a factory at Melingriffith, near Cardiff, Wales.

This 90,000 sq. ft factory will have equipment installed for the production of bumpers and will eventually employ about 300 people.

The already sharply increased demands of the car firms have been met by the setting up of a flow line production layout at Pyrene's main works, at Brentford, West London. Improved plating processes are to be used at both plants.

These steps are the first phase of a two-year development scheme. The aim of the company is to keep its capacity ahead of the needs of the motor firms and also to have capacity for producing spares for British cars whether sold at home or in the export markets.

Depressed July Trade Figures

The Board of Trade's provisional figures for July's imports and exports are gloomy reading. In recent years the July figures have been notably better than those for June, but this time, with the Prime Minister's exhortations still relatively fresh in the mind, exports fell while imports rose, worsening the trade gap by £33 million.

The official figure for the trade gap in July is £104 million, compared with £71 million in June. This is the worst that the trade gap has been for three years.

The adjusted value of British exports for July was £272 million, £16 million less than June's figure of £288 million. Imports rose from £370 million in June to £388 million.

Partly due to the high interest payments made on money deposited in London, the foreign reserves and gold situation is much brighter than the trading position. The July figures have not been affected by the seamen's strike. The August import-export results may be the sufferers from that action.

Consultants for Prison Electrical Work

The Prison Commissioners have appointed the design, development and consulting engineers, E. G. IRWIN and Partners, to act in some of the programme of electrical and mechanical work being carried out in certain prisons.

Four of the prisons where work is going on are Wormwood Scrubs, London; Lincoln Gaol; Wakefield, in Yorkshire; and Styal, in Cheshire.

The Industrious Irish

Whatever the present picture of the United Kingdom's export performance, there is much more optimism across the Irish Sea.

The recently released report on the year up to the end of this March of the Irish Export Board shows that Eire's export performance improved by 5 per cent during the year, to a total of £136 million. Food, drink and tobacco brought in almost £46 million of this but industrial goods, only 12 per cent of the total in 1955, have now increased to 22 per cent. This figure rises to 30 per cent if allowance is made for the £8 million parcel post, much of which is concerned with small export orders.

The value of exported manufactured goods and raw materials rose from £26 million in the year 1958-59, to £40 million.

While Britain and Northern Ireland took almost £100 million of Eire's food and goods the United States was second largest importer. Her imports, worth £12·4 million, were the highest yet received there from Eire.

Strong Support for 1961 Sydney Fair

That valuable shop window facing the Far East and the South-West Pacific, the Sydney Trade Fair, which will be held from 1 to 12 August, 1961, has already had 116,000 of its total 128,000 sq. ft of indoor space booked by countries including Britain and Western Germany, Japan and Korea.

The British Board of Trade has taken 4,000 sq. ft. Among the other countries and organisations taking space are the French Chamber of Commerce (15,000 sq. ft), Italy (14,000), Western Germany (10,000), Austria, the Netherlands, Israel, the Japan Trade Centre, China, Korea India and Czechoslovakia.

The Soviet Union is also expected to make an appearance on a large scale. An exhibition showing Russia's satellites, rockets and missiles may be sent.

The lengthening list of companies who will be at Sydney now includes Schweppes, Horrockses, British Nylon Spinners, Bowaters, Pan American Airways, the Singer Sewing Machine Company, Hoover, the British Motor Corporation and W. and T. Avery Limited.

The British end of the fair is being run by INDUSTRIAL AND TRADE FAIRS Limited.

St. Lawrence Seaway—Year Two

The St. Lawrence Seaway is now well into its second year of operation. What are the prospects for the new season? On the whole they are reported to be better than last year.

Cargo traffic in 1959, both through the Seaway and the Welland Canal, was below expectations. The late spring thaw, the United States steel strike, the drop in Canadian grain exports and the sluggishness of American overseas trade all cut down traffic. Also not all the Lake ports had completed their arrangements for handling more ships and higher tonnages. And some seagoing captains are said to have found these unfamiliar waterways hard to navigate. Nevertheless, 3,330 vessels used the Seaway in 1959, and over 1,000 of these (carrying 60 per cent of the tonnage) could not have used the old undeepened St. Lawrence canal.

Lake vessels carried almost 70 per cent of Seaway tonnage. Most of this was in bulk cargoes—iron ore, grain, coal, pulpwood and rough or crushed stone. Only half a million tons of general cargo went from Lake ports to foreign destinations.

With cargoes below the forecasts the revenue from tolls was also below expectations. In fact, revenue was not enough to meet the repayments of debt due in 1959 and the Seaway Corporation must cover its operating costs and repay debts within 50 years. The authorities, however, are reported to be confident that as traffic develops over this early period they will be able to meet their obligations without raising the tolls and the estimates for this year have been made on this assumption. Indeed, traffic on the Seaway is expected to be between 25 and 29 million tons, compared with 20·6 million tons in 1959, with bulk cargo again likely to account for 90 per cent of total tonnage. With the steel strike over, Labrador iron ore should be shipped in much greater quantities.

And what of general cargo on which the planners of the Seaway set such high hopes? It is expected that tonnages will rise for a number of reasons. Experience gained last year will mean faster handling, better service and fewer delays. In particular, congestion on the Welland Canal should be reduced as a result of work carried out during the winter. On the other hand, increased competition is expected from the railways, which have cut freight rates on grain moving to the Atlantic ports by 25 per cent.

All told, however, the St. Lawrence Seaway Authority are optimistic about their prospects and expect Year Two to be even better than Year One was to have been.

USA Turbine Contracts for English Electric

The ENGLISH ELECTRIC Company have been awarded a £297,000 contract by the United States Department of the Interior for two 85,000 h.p. hydraulic turbines.

The turbines, of special design with two interchangeable runners, are for the US Bureau of Reclamation's Trinity Power Plant in California. The two runners, one operating at a 426 ft head and the other at a 334 ft head, have been called for by the seasonal changes in the water level of the storage reservoir.

Greater plant efficiency will be obtained by the use of the interchangeable runners.

Design work and model testing on the turbines is to be done at the Rugby works of English Electric. The turbines will be manufactured at the Netherton works, near Liverpool.

A number of other contracts for which English Electric were low bidders were not awarded to the company. Mr. N. B. Bennett, the assistant commissioner of reclamation, said it had been decided not to award more than one contract each to English Electric and to a Japanese firm, as, he said, they had not yet had the opportunity of showing what they could do.

The Japanese company was HITACHI, who were awarded a £237,000 contract for hydraulic boilers.

New Steel Equipment Subsidiary

A new United Kingdom subsidiary supplying strip and tin mill equipment has been established with its head office in London. The new company is WEAN-MILES Limited. It has been set up by the United States concern WEAN ENGINEERING, of Warren, Ohio.

Wean-Miles will manufacture and sell in Great Britain plant from the range of equipment which the United States company is now marketing in its home market and overseas. Through Wean-Miles, Wean Engineering is at present working on a variety of equipment for the British steel industry. This includes one high-speed electrolytic tinning line, two continuous strip pickling lines, two high-speed shear lines, and a high production continuous strip annealing line for tinplate.

This is all being made in England, under the control of Wean engineers.

Espresso Coffee Machine Wins on Design

The most widely used Espresso coffee machine, the Gaggia, has been developed continuously during the last eight years. With the latest design, the operator is relieved of heavy manual exertion.

THE term Espresso was invented by the Italians to describe coffee that is infused at the time it is served, as opposed to coffee that is made in a pot or urn and then poured as required.

EARLY DEVELOPMENT

Gaggia (London) Limited, 18 Old Compton Street, London, W1, were the first to introduce Espresso coffee machines successfully into this country, about 8 years ago. To do so, certain slight modifications had to be made to the original Italian design in order to comply with the requirements of British water supply undertakings. The most important of these was that of feeding the boiler from a separate tank instead of direct from the mains, as in this country water mains cannot be connected direct to a pressure vessel even through isolating valves.

In a British installation the float controlled supply tank is usually to be found beneath the counter with the motorised pump unit alongside. Under these circumstances the pump is normally a Stuart Turner No. 12 unit, but in cases where the pump unit has to be mounted some distance from and below the tank, a larger Mono HM11 machine is available at slight extra cost.

The coffee machine itself is in a continuous process of development. In the first machines control was entirely by hand, but to take the onus off the operator, automatic control has been introduced as far as possible. For instance, in the first machines the boiler water level gauge had to be watched and the pump switched on or off by hand when necessary. Now the pump is controlled automatically by means of a Ronald Trist level switch. Similarly, the heater, previously hand operated, is now controlled by a Teddington mercury pressure switch, worked from the boiler pressure.

FEATURES

The Gaggia Espresso coffee machine consists basically of two distinct parts: the boiler and the "groups." The primary function of the boiler is to provide hot water for infusing the coffee, and it also supplies steam for warming the milk and for cup sterilising. The groups, of which there are any number between one and four, or six depending on the size of the machine, perform the combined function of infusing and dispensing the coffee.

Both the boiler and the groups are mounted on a decorative chromium plated chassis, always placed on the serving counter. The boiler is actually concealed within the chassis, while the groups are mounted on the serving side. The top of the chassis incorporates a cup warming and sterilizing rack, covered by a domed transparent hood. The base of the chassis beneath the groups forms a tray for standing the cups, with a drainage grid.

BOILER

The boiler is made of solid drawn copper, suitably plated, and is cylindrical with slightly dished ends. It contains two electric heating elements, normally both in use together. To save time when warming up from cold (which takes approximately 20 minutes when the electric heaters are used alone) an external gas burner is also provided as standard. This can be used on its own in the event of a failure of the mains electricity supply.

A pressure gauge is fitted, together with a float safety valve set to blow off at a pressure of between 20 and 25 lb per sq. in depending on the type of machine. Boiler fittings above water level also include cocks for the milk-warming and cup-sterilising branches. Connections to the groups themselves are below water level to ensure that no steam passes to them. The boiler is not lagged, but is partly surrounded by ducting to convey the heat from the gas burner. The decorative chassis is, however, lagged internally for protection of the operator.

THE GROUPS

The groups are fairly intricate and a great deal of thought has been put into the present design. Gaggia's Espresso machine most commonly employs groups known as the 1G type. In the 1G a tall handle projects from the head, and a complete pull through about 150° down towards the operator is needed for every cup of coffee produced. Fig. 3 depicts a typical machine, on which these handles are prominent. The handle on each group is attached to a splined shaft which enters the head and carries a pinion at the inner end. This engages a rack cut near the top of a vertical rod attached to the piston which works inside the body of the group.

Fig. 1 is a simplified section through a 1G group. The piston, of approximately 2¼ in diameter, is free to slide up and down within the cylinder, which is formed by a number of inserts within the body retained by a collar. The collar is screwed into the body, thus compressing the rubber sealing rings and gripping the distribution ring. A series of asbestos and brass sealing washers is also provided, this combination of seals having been found most effective for obviating hot water leakage past the piston from the annular spaces each side of the distribution ring. These spaces are in direct communication with hot water in the lower portion of the boiler, and are interconnected by means of a few holes in the ring to promote rapid flow. In the normal position, i.e. with the handle up and the piston down, the radial holes in the piston are well below the annular spaces and are sealed off from the hot water through the lower rubber ring and washers. Consequently no hot water can reach the space in the centre of the piston, and there is no flow.

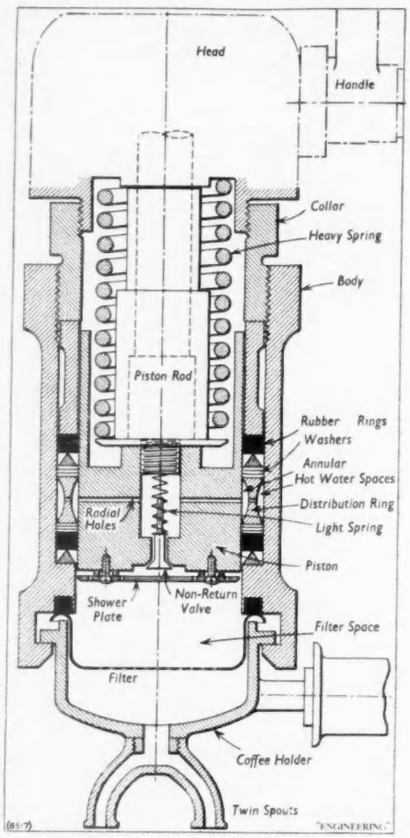


Fig. 1 Section through a 1G Group

MAKING COFFEE

When it is desired to make coffee, the grind (of specific fineness), is placed on the filter in the coffee holder, which is then clipped to the bottom of the body as shown. The handle is pulled down, thus raising the piston rod and lifting the piston against the heavy spring to the position

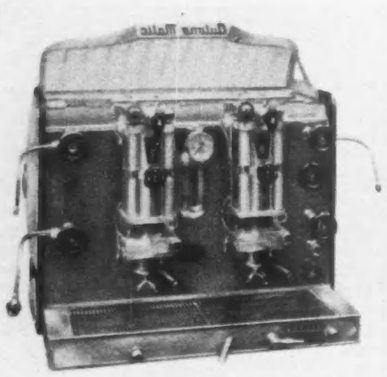
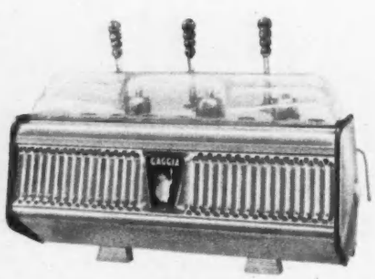
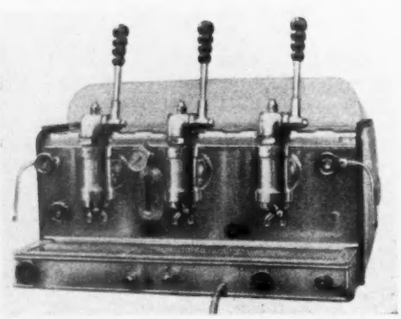


Fig. 2 (left) Gaggia Aromatic machine with two 8G groups. Fig. 3 (centre) Espresso machine with three 1G groups as the customer sees it. Fig. 4 (right) As seen from the serving side.





shown, total travel of the piston being about 1 in. Hot water from the boiler can now flow through the annular spaces and the radial holes into the central space in the piston, and thence to the filter space containing the grind, via the non-return valve. At other times this valve is held shut by a light spring. A ratchet device attached to the head automatically holds the handle down at the end of its travel.

After a pause of about 4 sec the filter space is filled, and the coffee is then ready to be infused and dispensed in one operation. The handle is given a tug to release the ratchet, then the heavy spring takes charge and pushes the piston down. This forces the hot water under considerable pressure through the grind which is thus infused, and the coffee escapes through small holes in the filter through the twin spouts into the cups placed beneath. Screwed to the underside of the piston through spacing washers is a shower plate consisting of a perforated disc. This ensures even distribution of the hot water over the coffee grind, and also discourages the grind from entering the non-return valve. A sufficient quantity of grind is placed in the filter for one of two cups, placed under the spouts, and the handle is pulled down once or twice to give one or two infusions. Milk in a jug, previously warmed and frothed by means of the steam jet, is added afterwards as required by the customer.

MATERIALS

The body and main parts of the group are of brass suitably plated to resist action between the metal and the hot water or coffee. The group is fully chromium plated externally for the sake of appearance and cleanliness. The piston is made of brass with the outer surface nickel sprayed, machined and ground to a bright finish with a close tolerance.

LATEST DEVELOPMENTS

One of the most difficult problems to solve in developing a satisfactory group design was that of maintaining effective long-life sealing between cylinder and piston, without throwing too much of a strain on the waitress operating the handles. Last September Gaggia introduced a new and improved group known as the 8G, in which the physical effort of pulling the handles is eliminated entirely. In the 8G a second piston is attached to the upper end of the piston rod in tandem with the group piston. This dispenses with the handle, rack and pinion arrangement of the 1G, since steam from the boiler acting on the upper piston now performs all the work. A small knob on the front of the group controls admission of steam for piston raising. Forcing the piston down for infusing and dispensing is also done by steam, under the action of an automatic pre-set timing device.

Another considerable advantage of the 8G group is that a pressure of about 120 lb per sq. in on the piston for infusing purposes now becomes a practical reality, roughly twice as great as in the 1G. This means that a finer coffee grind can be used, with even more effective infusion and hence a better cup of coffee. Gaggia use the term Aromatic for coffee produced by the new machines, to distinguish it from Espresso which applies to coffee made on the earlier models. To cope with a large rush of customers and enable the machine to produce coffee at its maximum rate for a long period without deterioration of the product, a further refinement has been incorporated in the Aromatic machines. This comprises an automatic preheater wherein steam passes via a small branch through a chamber for preheating the feedwater. Fig. 2 shows an Aromatic machine with four 8G groups.

PERFORMANCE

Gaggia claim that both Aromatic and Espresso machines can make 80 to 100 cups of coffee per hour from each group, and that this hourly quantity can be made from 1 lb of coffee grind. For installations where large quantities of coffee are required at once, for example, in canteens, a "bulk" group is also available for fitting on a standard machine in place of some or all of the 1G or 8G groups. Each bulk group is capable of producing 32 cups every 10 minutes.

INSTALLATION AND TESTING

Installation is carried out by Gaggia's own technical staff. Each machine, though thoroughly tested before leaving the works in Milan, is tested again in London before being sent out for installation. Service staff attend the initial operation of every machine and instruct the restaurant staff in its use. Full after-sales service is offered, and in addition a 24-hour 7-day emergency service is provided.

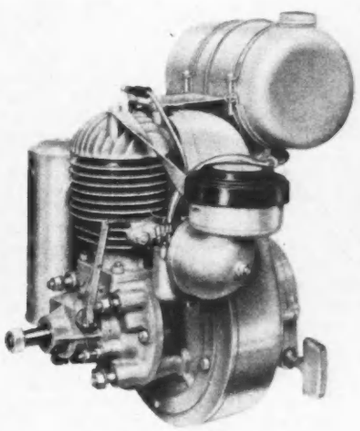
I.C. Stationary Engines for Industry and Agriculture

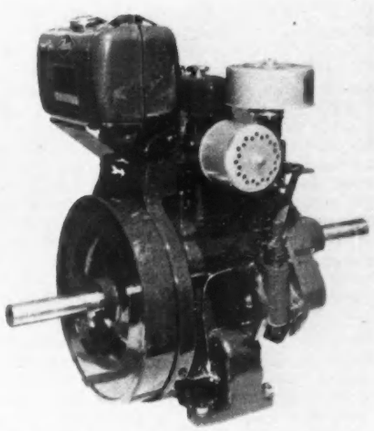
The range of light vertical and V type internal combustion engines available in this country for stationary driving purposes is continually being expanded in the face of popular demand, particularly in the case of diesels. Capacities range broadly from ¼ b.h.p. up to over 100 b.h.p., and the smaller sizes are particularly attractive for agricultural applications, such as mixers, balers, chain saws, cultivators, elevators, hedge and grass cutters, milking machines, etc.

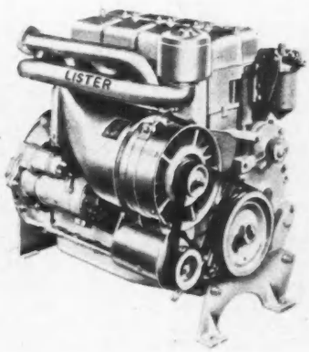
One of the smallest units, the single cylinder two-stroke JAP model 16H of 4 b.h.p. is shown top left. Simplicity and compactness are the chief keynotes in its design. The full range of JAP and Villiers 2-stroke and 4-stroke engines extends from ¼ to 14 b.h.p All are air-cooled petrol engines, and are manufactured by the Villiers Engineering Company Limited, of Marston, Wolverhampton

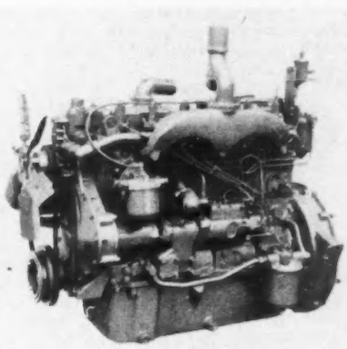
Most other manufacturers appear to be concentrating on air-cooled diesels, although a more limited range of petrol engines is sometimes marketed. Both Petters Limited, of Staines (a member of the Hawker Siddeley Group) and the Lister Group of Dursley produce air-cooled 4-stroke diesel engines as small as 1½ b h.p. Petters' air-cooled range starts with the single cylinder PAZ 1 rated at 1½ to 3 b.h p at 1,000 to 1,800 r.p.m., shown top right, and finishes with the PDV 8 diesel 8-cylinder engine rated at 72 to 108 b.h.p. at 1,200 to 2,000 r.p.m. Petters also manufacture the 1, 2 and 3-cylinder Armstrong Siddeley air cooled diesels rated between 10 and 33 b.h.p., together with water-cooled engines over a more limited range. Lister diesel engines range from 1½ to 72 b.h.p. air-cooled, and from 4 to 90 b.h.p. watercooled. The 4-cylinder air-cooled SL 4 engine has recently been added to their range; it develops 19 b.h.p. at 2,000 r.p.m. and is shown bottom left.

Ruston and Hornsby Limited, of Lincoln, make air-cooled 4-stroke diesel engines starting with the YBA range, the single cylinder version of which has a lowest rating of 4 b.h.p. at 1,000 r.p.m. The biggest is the 6-cylinder 114 b.h.p. air-cooled pressure-charged model 6YDAX. Water-cooled engines are produced with the same ratings but extending into much larger sizes. Perkins Engines Limited, of Peterborough, do not include very small engines in their range, which consists of water-cooled 4-stroke diesels. Recently they produced a new engine specifically designed for propelling the larger types of combine harvester and crawler tractors. It is the Six 288(TA), a 6-cylinder unit developing 65 b.h.p. at 2,000 r.p.m., shown in the bottom right illustration.









Preserving Food Without After Effects

Refrigeration and canning will soon have a powerful new rival. Accelerated freeze-drying has now reached the stage of commercial application as a batch process. Development work on a continuous process is already showing promise.

ACCELERATED Freeze-Drying, or AFD, is the name given to a new process for the treatment of foodstuffs for preservation. At present AFD is still in its infancy, but in a few years time it may rank in importance with refrigeration and canning.

Later this year the Irish Sugar Company will be opening the world's first commercial installation, at Mallow, Co. Cork, designed and built by Vickers-Armstrongs (South Marston) Limited, who are at present leading the field in development of the AFD process. The Mallow plant is designed to handle approximately 5 tons of prepared fruit or vegetables every 24 hours (with 3-shift operation); it represents the culmination of a long search for a commercially feasible freeze-drying process by the Ministry of Food, which started at the Aberdeen Food Research Unit in 1948. Although drying, or dehydration, is probably the oldest known method of food preservation, a serious disadvantage of earlier processes was the inability to restore the product to anything like its original taste and form.

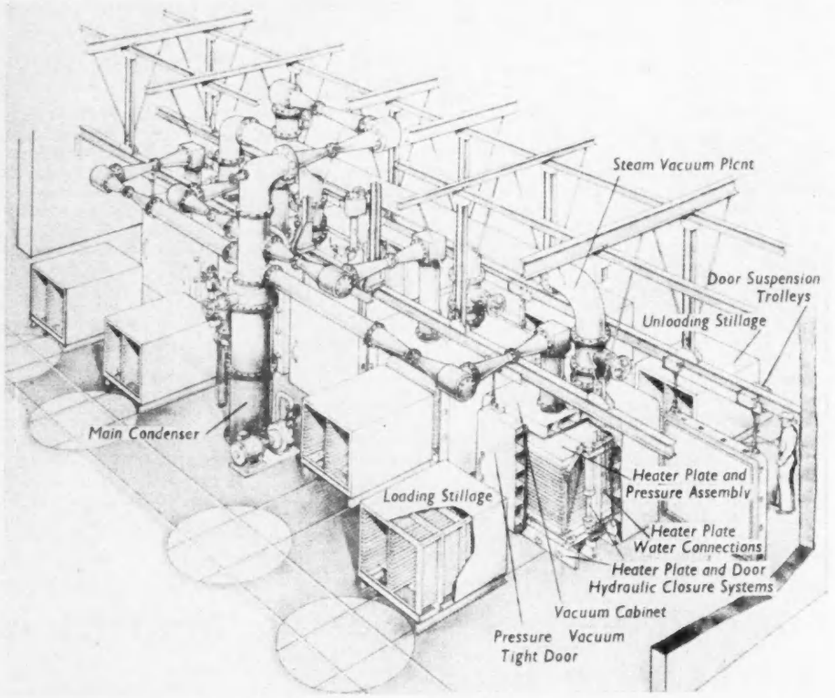
Vacuum-dried foodstuffs are well known to have many commercial advantages over food not so treated. Among these are extended storage life at ordinary temperatures, ease and economy of transportation, and elimination of bulky storage equipment. These advantages become even more pronounced if removal of moisture is effected from the solid ice phase because there is no shrinkage of the material, virtually no impairment of taste, texture or colour, and reconstitution is simple. Furthermore, the product derived from freeze-drying can be subjected to prolonged storage at ordinary temperatures, provided that it is packed in a material impermeable to moisture and oxygen, and is not exposed to direct sunlight.

PROCESS DEVELOPMENT

The basic process concerns removal of the water content from the pre-frozen foodstuffs by direct conversion from ice to vapour without passing through the liquid phase. This gives a product with characteristic freeze-dried properties, i.e., a rigid porous structure which has not collapsed or shrunk into a dense mass.

One of the major design problems was to find a way of transferring sufficient heat to the food. The process Vickers-Armstrongs are using now, previously developed at Aberdeen, relies on direct conduction of heat from top and bottom heating plates to the food, via expanded metal sheets. These are essential to the process and assist vapour release. The food and the plates are held in contact by subjecting them to mechanical pressure, which does no damage to the food since it is pre-frozen. Attention to detail design of the machinery with a view to simplification and speeding up the drying process has considerably reduced the costs involved, and drying times as low as from 5 to 7 hours can now be attained, depending on the product.

The frozen foodstuffs are placed on special trays in a vacuum cabinet, which is then rapidly evacuated to 1 mm Hg. Heat is applied to sublimate the ice, the temperature being controlled to ensure that the food itself is unaffected. The Mallow plant, designed about four cabinets, is shown. This is typical of the equipment currently available using contact heating, around which most of the research work in this country has so far been directed.



One of the most remarkable properties of AFD products is that most types of foodstuff can be reconstituted in a few minutes merely by placing it in water. Precooked food can be made ready for serving by using hot water instead of cold. In many cases it is impossible to distinguish processed from unprocessed foodstuffs either by appearance or taste, for example, fish, meat and certain vegetables. Another remarkable fact concerning these foods is that the amount of water necessary for reconstitution need not be controlled, as it has been found that just the right quantity will be absorbed and the remainder can be drained off. This does not apply to every product, milk and eggs for example.

SYSTEM DETAILS

The total capacity of an AFD system depends on the number of vacuum cabinets, the size of the cabinets themselves being limited. Taking Mallow as typical, each of the four cabinets measures approximately 6 ft by 6 ft by 6 ft 6 in long internally. Each is capable of holding 30 trays measuring 6 ft by 2 ft, giving a total tray area of 360 sq. ft and a throughput of roughly 1¼ tons of every 24 hours per cabinet, or 900 lb per charge. The cabinets are of mild steel welded construction with all internal surfaces protected with an epoxy resin coating. There are two doors, one at each end, supported by overhead rail and chains and rubber sealed. They are operated hydraulically by means of a 4-cam closure system on each door.

The heating plates are arranged in a tier with spaces between for the loaded trays, and heat is applied to the food along both top and bottom surfaces. The heating plates contain hot water circulating through an internal counterflow labyrinth so arranged that the temperature is uniform over the plate surface. Heat control is by valves at the hot water inlet connections.

Pressure is applied to the food on the trays by squeezing the heating plates together, this being performed by four hydraulic cylinders, one at each corner of the tier. A system of linkage ensures that the spaces between the heating plates remain equal as pressure is applied. The magnitude of the contact pressure is controlled manually to ensure that no damage occurs to the food under treatment, the maximum pressure used being about 8 lb per sq. in for meat, reducing almost to zero for soft fruit such as strawberries. All moving parts are made of stainless steel to resist corrosion.

The trays themselves are pressed from 20G stainless steel sheet and consist of both top and bottom coverings with expanded aluminium inserts to allow vapour release. Two loading stillages are provided per cabinet, one for each end, running on guides. The stillages are designed to protect the food during transit to and from the cabinets, and are so arranged that the trays are carried in tiers corresponding to those in the cabinets. A simple coupling device on the trays enables them to be unloaded from the cabinet into a stillage at one end, at the same time drawing the trays containing the next charge into the cabinet from a stillage placed at the opposite end, to economise in manpower.

Creation and maintenance of the vacuum is by means of a system of steam ejectors in combination with a refrigerator condenser. Hot water for the heating plates is supplied by a steam-water heat exchanger. Total water circulation for the whole system works out at 60,000 gallons per hour at 65° F, plus 7,500 lb of steam per hour at 140 lb per sq. in for the ejectors and heat exchanger.

FUTURE DEVELOPMENTS

Substitution of radiant infra-red heating for the hot water system is currently being investigated. Its prime advantages are the elimination of the flexible pipe connections. Present tests, look very promising, though indications are that food drying times may be slightly increased.

In order to popularise the AFD process for commercial application, however, it is considered essential to develop the system for continuous instead of batch processing, and Vickers-Armstrongs are pursuing very active investigations along these lines. The study of infra-red heating is closely associated with development of a feasible commercial continuous process.

Aerodynamics of Harvesting

An aircraft company develops a forage harvester from scratch on aerodynamic principles, and cuts power consumption by half.

To compensate for a contraction in aircraft business, the Gloster company set out to find new activities which would make full use of their existing facilities in plant and skills. One departure has been the development of a forage harvester using aerodynamic principles. One version is shown in Fig. 1.

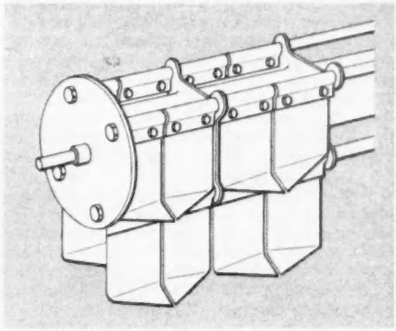
Gloster Equipment Limited, a division of Gloster Aircraft, were eager to make some kind of agricultural machinery which promised to have a fairly long-term future, and forage harvesters seemed the answer. Agriculture was the biggest industry in the world, said Mr. W.W. Downing, executive director of Gloster Equipment, so it seemed reasonable to increase the group's stake in it. Forage harvesters were first introduced a few years ago as a result of the gradual change from hay-making to silage-making—that is, fermenting grass or other green crops in an air-tight pit or container, instead of sun-drying them as in hay-making. This process preserves most of the proteins in the crop.

In principle, conventional forage harvesters comprise a rapidly rotating drum or axle carrying four rows of blades or flails, which cut off the crop at ground level and to some extent lacerate it. The impact of the flails then throws the crop up and out of a chute and into a trailer, much as the blades of a lawn-mower throw the cut grass into the grass box. The harvester is pulled behind an agricultural tractor, which also supplies power by way of a shaft drive.

Fig. 1 (left) Gloster off-set forage harvester with swivel nozzle.

Fig. 2 (centre). Off-set forage harvester in action.

Fig. 3 (right) The angled blades of the Gloster forage harvester slice through crops like a guillotine and embody aerodynamic principles.



The main weakness of such forage harvesters is the amount of power they use. Most require a tractor of at least 35 horse-power, while some need 25 horse-power just to revolve the flail assembly at its cutting speed. None could operate successfully with the small 20 horse-power tractors which represent almost half the number of tractors in the United Kingdom. Gloster's therefore set out to design a harvester which would use much less power than any other model on the market.

Take the case of a lawn mower: unless the blades spin quickly enough the grass will not reach the grass box; it will fall back on to the lawn. With a forage harvester that would be disastrous. If the crop is not thrown right up the chute and out at the top, it tumbles back down, chokes up the flails and jams the harvester in a few seconds. Thus if the flails alone are used to eject the crop, they must be rotated at very high speed.

But the National Institute of Agricultural Engineering pointed out that the power consumption varied as the cube of the rotational speed, so that if some means could be found to assist the crop up the chute the revolutions could be dropped and the power reduced.

It was here that aerodynamics came into the picture. The revolving flails generated a certain amount of draught in the chute, which most manufacturers regarded merely as a nuisance. If this draught, or air-flow, could be increased and properly directed, it could be used to blow the crop up the chute instead of relying on the flails to knock it up like a set of ping-pong bats.

Gloster's chief aerodynamicist, Mr. D. I. Husk, supported the theory: "The first thing that struck me was the inefficiency of normal blade arrangements when considered as an air impeller. All flail type forage harvesters have wide gaps between adjacent blades in each row and successive rows of blades are staggered so that one revolution of the drum is needed to give one complete cut over the width of the body. Using these open rows of blades to impel air is like trying to swim with your fingers apart."

Mr. Husk's proposal was a complete departure from established practice. Four complete rows of blades would act as a very efficient fan and even at very low speeds still produce a strong enough air-flow to whisk a crop up the chute without relying on mechanical impact.

Other refinements followed. First, it was necessary to improve the air flow in the ejector chute. Mr. Husk's aerodynamicists took pressure readings at different points of the chute. "We studied the air flow through the chute in the same way as we study the flow over the wing of an aeroplane," he remarked. "We kept taking readings and modifying the design of the chute until we got a very smooth, uninterrupted air flow which would carry the crop up from the cutting blades and blow it out the top into the trailer."

At the same time, Mr. Downing was giving his attention to the blades. His aim was to make a blade with an inclined cutting edge which would slice through the crop with minimum effort like a guillotine, instead of hacking its way through like an axe. The resulting angled cutter, sketched in Fig. 3, is an exclusive feature which has now been patented.

During the harvester's development, Mr. Downing had access to facilities which few manufacturers have on their doorsteps. One was Gloster's strain gauge laboratory. Strain gauges are commonly used in structural tests on aircraft, and in this case were used to measure the torque on the shaft drive between the tractor and the harvester. By measuring also the shaft's speed of rotation, it was a simple matter to calculate the harvester's power consumption. After each alteration to the design of the blades or the chute, Gloster's strain-gauge technicians measured the machine's power consumption.

"They analysed thousands of readings from tests on both our own harvester and competitive models," says Mr. Downing. "The results showed that our production harvester, when static, requires only six horse-power against the 15 horse-power of its rivals."

Mr. Downing admits that some of the Gloster forage harvester's advantages were quite unexpected results of the basic design. "The air intake of conventional harvesters comes from below," he points out, "so it pulls up quite a lot of dirt and stones along with the crop. On the Gloster machine, Mr. Husk decided on aerodynamic grounds that the air would be best introduced at the sides of the chute, above the blades. The consequence is that this machine picks up only what the blades actually cut, and so gives a much cleaner product."

A more obvious consequence of the design is that the four complete rows of blades chop the crop much more finely than do the widely-spaced blades on other machines. With crops of up to 8 ft in height, the degree of laceration is of great importance.

Naturally, the change from building aircraft to building agricultural machinery meant some new production techniques in the sections of the Gloster factories concerned. "The main trouble was with welding," says Mr. F. E. Davenport, production manager. "We seldom used steel thicker than 10 gauge on aircraft, but on the forage harvester we use commercial mild steel up to $\frac{1}{8}$ in thick.

Although the work is different to their traditional work on aircraft, Gloster's are making the fullest use of existing facilities such as their 600 ton press. This machine is used for pressing out the sides of the cutter assembly, for example, complete with all bolt holes, in a matter of seconds. "If we had to hand-saw these plates and drill all the bolt holes we could never sell a machine of this quality and performance at the same price as a conventional forage harvester," says Mr. Davenport.

Mr. Davenport adds that the sides of the chute are guillotined to size using a template as pattern. "All the parts of the chute must fit snugly together if the air flow is not to be affected at the joins. Out men seldom touch a file and never use a hammer to force parts together. If a section doesn't fit, they reject it."

As an experiment, an agricultural dealer was invited to a race of forage harvesters. The dealer used another form of harvester; Glosters entered their own model. The course was a field of kale, several feet high with stalks like young tree trunks. Each harvester was hitched in turn behind a Baby Ferguson tractor and set to work cutting kale.

"The other harvester managed to tear its way through with the tractor in bottom gear," relates Mr. Downing. "Our machines went through without the slightest trouble. When we tried another lap with the tractor in second gear our opponent stopped dead within a few feet. At the third attempt he stripped the driving splines on the tractor drive. The Gloster machine never faltered—not even with the tractor in third gear. It was a complete vindication of the scientific theories behind our design, through which we have cut the power consumption of forage harvesters by about 50 per cent."

Hydroponics Will Feed Men on the Moon

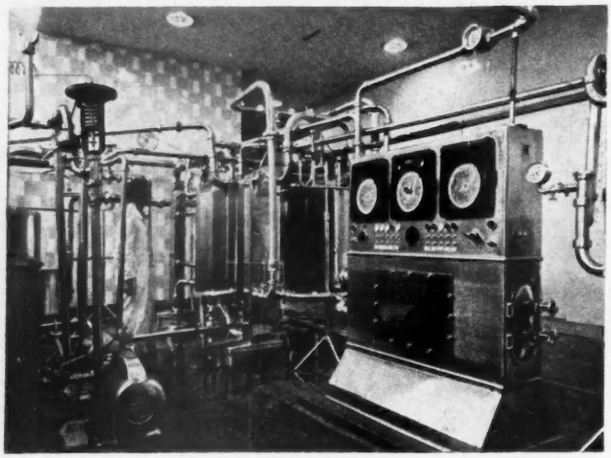
As man's environment is forced to yield ever greater quantities of food, cultivation must become increasingly mechanised and systematic. Engineering will finally usurp the functions of the farmer when men, establishing themselves upon the barren Moon, begin to grow their food in process plants.

By G. V. E. Thompson, B.Sc., B.Sc.(Eng.), A.R.C.S., F.R.I.C.

THE dawn of civilisation on Earth was closely linked with the beginning of agriculture. Civilisation in turn made man less dependent upon his immediate environment so that with the development of engineering he could venture into areas hitherto inaccessible. He could reach even the sea bed and the skies. His explorations were often prompted by the need of growing populations to satisfy their ever accumulating appetites. Engineering is now being pressed into service to increase the regions under cultivation, and if world population continues to rise exponentially, it will ultimately be necessary to farm the bottom of the sea, a practice already within sight. At the same time a premonitory consciousness of Earth's inadequacy may send man tentatively into space. Again he will be called upon to secure his food supplies, perhaps by growing food in tanks under controlled conditions. With the advent of "soilless cultivation" in chemical solutions—a technique known as hydroponics—biochemical engineers will begin to play a major part in food production.

Within the next decade man will commence operations upon his second world—the Moon. The new lunar civilisation will be dependent at first upon supplies of food brought from Earth, but it is economically and biologically desirable that native agriculture should be established as soon as possible. It will require about 200 tons of propellents to transport one ton of food and drink to the Moon, and the consumption of that ton of food will eventually yield one ton of biological waste products. On the Earth these waste products would find their way—via a series of chains and cycles—back into food production. If the lunar population grows steadily, as is to be expected, there will come a time when some form of recycling becomes necessary there also.

With no seas, no atmosphere and no soil, ordinary methods of farming are out of the question and hydroponics is most likely to be used. Tanks, pipelines, pumps and similar equipment would be obtained by cannibalisation of supply rockets; the nutrient solutions would be replenished with the sewage to which will be added any necessary trace elements. The absence of an atmosphere makes it imperative for the system to be housed in a sealed building. It has been suggested that this should be built or roofed in transparent plastic to admit sunlight to the growing plants, but there is no advantage in doing so. On the Moon there are roughly fourteen terrestrial days of sunlight followed by a similar period of night. Artificial light would have to be supplied during the lunar night, and therefore might just as well be used continually.



The control of biological processes by engineering methods is already well established. The APV continuous ice-cream mix pasteurisation plant at the Lyons Maid factory is required to hold the mix within close temperature limits for a critical period of time, thereby destroying heat-allergic organisms without encouraging thermophilic ones to multiply. Equipment of this kind perhaps foreshadows the plant that may eventually be used for hydroponics.

This procedure has all the advantages of continuous over batch processes and avoids the need to provide for variations in irradiation throughout the long lunar day (the noon radiation would be excessive as the screening effect of an atmosphere is absent).

The plants grown in this way could be eaten directly, thus reducing the biological cycle to its absolute essentials. It would be preferable, however, to feed them to small animals (the battery hen is an obvious choice) to make the diet both more palatable and varied.

Hydroponics will be even more essential during space voyages to other planets. Even with the nearest planets, Mars and Venus, the round trip would occupy a couple of years or so. No supplies could be ferried out to the vessel during this period, and take-off mass must be reduced to the absolute minimum. A closed biological cycle will have to be employed. As it is impossible to turn back on voyages of this kind, the cycle will have to be 100 per cent successful: crop failures, pests, or adverse "weather" conditions would leave the crew no hope of survival.

Practical work on this type of system has been undertaken in the United States for several years past (and probably also in the Soviet Union, for Russia's entire space programme is directed towards getting *man* into space ahead of other nations; instrument-carrying vehicles are tools only).

Algae have already been chosen as the most suitable plant, and investigations have been made into the most suitable types of algae, long-term behaviour of the system, methods of rendering the plant palatable, and so on.

It may seem surprising that this work is now in progress although man himself has not yet ventured even 100 miles out into space, but the problem of keeping men alive on a voyage to and from Mars is more difficult than that of building a vehicle to take them there. It will require many years' work to solve it, but the problem must be solved before design of the vehicle begins.

Agriculture has developed very slowly during the last few million years, but progress has been rapid since engineering methods were applied. Hydroponics is largely a matter of engineering; space feeding will be entirely so—it would be hopeless to depend upon "green fingers."

Controlled Farming by Lamplight Underground

Farms of the future may go underground where temperature, weather conditions, plant diseases, nutrition and lighting can be accurately controlled regardless of the season or weather. According to Mr. Robert L. Zahour, manager of application engineering for the Westinghouse lamp division, such foods as bananas, oranges, grapefruit, lemons and other items which are now raised almost solely in tropical areas, could be grown in entirely different climates—possibly in Alaska or Siberia. He stated that recently the Beltsville, Maryland, and Rutgers, New Jersey, agricultural experimental stations in the United States have discovered a narrow band of rays in light from incandescent bulbs and fluorescent lamps, which are largely responsible for plant growth. This research could lead, he believed, to the development of light sources which emit sizeable quantities of growth-stimulating rays.

Experiments in the use of lamps for stimulating growth in greenhouses had been conducted since the late 1800's and in 1937, Dr. A. M. Porter from the University of Connecticut and Mr. Zahour tried ordinary 25 watt household bulbs for heating hotbeds. The successful results from three consecutive seasons indicated that it was cheaper to use bulbs for this application than soil heating cable or active manure. In 1942, Professor A. B. Strand and Professor G. E. Zerfoss, from the University of Tennessee Agricultural Experiment Station, repeated the bulb method of heating hotbeds, and arrived at the same conclusions.

In 1949, Mr. Zahour and Dr. O. W. Davidson, plant research specialist at Rutgers University, planned a long term project in an "underground" greenhouse from which all daylight was excluded, to determine how much actual artificial light was needed to maintain house plants in healthy condition. After several years of research, Dr. Davidson discovered several plants which would grow satisfactorily under light bulbs or fluorescent lamps corresponding in lighting level to those used in offices and homes. These lighting intensities are about one-hundredth of noon-day sunlight.

African violets have a definite range of lighting levels to keep them blossoming continuously, Mr. Zahour disclosed. This range is between one-tenth and one-twentieth of noon-day sunlight. Outside of this range, African violets will maintain their foliage but rarely blossom. Like fertiliser and moisture in the soil, light feeds the plants. Light rays are converted into plant foods by the chlorophyl in the foliage. A plant can starve for lack of light, or it can get "stuffed" if it receives too much.

Prototype Rigs for Food Processing

Engineers familiar with designing materials-handling equipment and processing equipment meet a new challenge in food manufacturing. Not only must the equipment operate efficiently from an engineering point of view but it must also produce food that is appetising. A straightforward engineering approach to the design of a machine for cooling pies, for example, might adversely affect their taste or character. And the physical properties of the foods can often add further complications. The viscosity of molten chocolate, for example, is more difficult to characterise than that of fuel oils, and consequently pump and piping is more complex.

A certain number of engineering problems of this sort are handled by the British Food Manufacturing Industries Research Association at Leatherhead. Though the professionally qualified staff there are either chemists, physicists or bacteriologists, the practical nature of the assocation's services makes engineering considerations important.

Research at the Leatherhead laboratories covers a wide field, including chromatographic work, biochemical and microbiological research, as well as many investigations into specific foods and processes, including bakery materials, oils and fats, jam, pickles and sauces, meat and fish, sugar confectionery, and cocoa and chocolate. The engineering aspects are best seen by considering a number of investigations carried out in recent years.

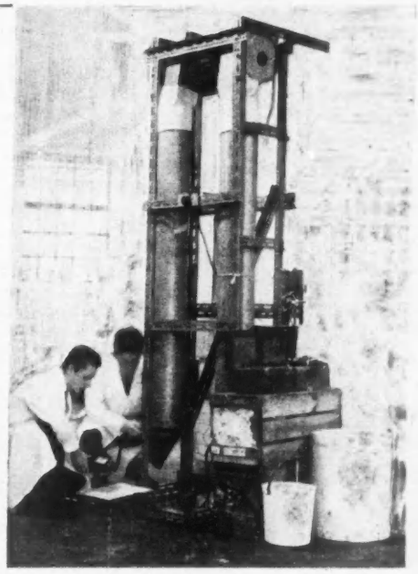
The drying of sugar confectionery is one of the topics currently being studied. Much confectionery is manufactured by deposition in impressions made in powdered starch in large flat trays. The trays are placed in stacks in heated rooms—generally referred to as stoves. Transfer of moisture from the sweet to the starch and from the starch to the atmosphere is being investigated at the laboratory. Changes of weight in the starch and in the sweets are determined while the material is losing moisture in an atmosphere of any desired humidity and at temperatures up to 70° C.

To obtain information on the conditions that actually exist in stoves, a number of studies have been carried out on manufacturers' premises. The drying stoves, which measured up to 72 ft long by 42 ft wide by 11 ft high, were instrumented to discover the distributions of temperatures, relative humidities, and air velocities; thermocouples were also inserted into certain sweets. Further experiments were carried out to discover the relationship between stoving conditions and the rate of drying of the sweets in starch. Conditions were found to vary widely at different locations within a given stove, and several modifications to stove design to produce more even temperature distributions have been proposed.

The general design and installation of machinery from the point of view of control of insect pests have been the subject of two reports by the association. Requests for translation of these into French, German, and Italian have been received in the past year. The growing use of electronics devices, such as metal detectors and automatic controls, is increasing but such equipment by its very nature is not easily cleaned.

Other investigations have been concerned with the physical properties of foods. Studies have been made of the piping properties of jellies and the extrudability of fats. An instrument has been developed which automatically records the thrust required to force a plastic material—margarine, say—through a small orifice at a uniform speed. The thrust varies throughout the extrusion of the sample and the lowest value has been found to correlate very closely with subjective assessments of "firmness" of the fat and to correlate inversely with subjective assessments of "spreadability." Since its development, an instrument, known as the FIRA/NIRD Extruder, has found application outside the food industry, notably in the evaluation of plastic explosives.

Investigations on the viscosity of molten chocolate have given support to a new rheological relationship for it. Earlier work suggested that molten chocolate exhibited Bingham body behaviour. That is, a definite minimum stress (termed the yield value) had to be applied before any flow took place; after flow started a rate of shear was produced proportional to the extra stress applied. It turns out, however, that chocolate behaves in a more complex way. The shear rate and stress are not so simply related; particularly just above the yield value. Unfortunately, it is just in this region that the viscous behaviour of molten chocolate is of great importance, for it is under such conditions that chocolate flows over centres in an enrober. At present, work is under way in connection with investigations into the effects of composition and processing on viscosity to find a useful method of specifying the behaviour of chocolate when molten. For this work an instrument has been developed which measures viscosity at very low rates of shear.



An experimental cooling tunnel used for determining the rate of cooling of meat pies.

Handling and Transporting Frozen Fish

Between them, the Department of Scientific and Industrial Research and the Agricultural Research Council have a number of laboratories, conducting research into almost every conceivable aspect of food. Quality, production, pest infestation, storage, handling and transportation of all types of food, are just a few of the topics dealt with by these laora t ories.

One of the best, and oldest established of these laboratories is the Torry Research Station, at Aberdeen, which is concerned solely with fish, particularly its preservation and storage.

Handling and transporting frozen fish comes high on the list of priority at Torry, since these are among the main factors governing both quality and wastage. A number of theoretical and experimental studies have been made of the rate of heating packages of frozen fish exposed to normal room temperature. Typical of the findings of this type of work has been the discovery and analysis of the freezing/thawing relationship of fish, knowledge of which has enabled improvements to be made in fish handling, right from the trawler to the shop.

The thermal conductivity of thawed fish flesh has been found to be about one-third of the frozen flesh and in consequence, under practical conditions, the time required for thawing by thermal conduction is about three times as long as that required for freezing. Under industrial conditions lengthy thawing periods can be a serious embarrassment because of the large amount of floor space and handling required. Furthermore, it is known that fish must be individually removed from composite blocks as they thaw and then immediately chilled or processed, if damage to texture is to be avoided.

In view of this and the steadily increasing large-scale further processing of cold stored fish, frozen in blocks on shore or at sea, the need for much speedier thawing has become urgent. In the past, attempts have been made to thaw fish by radiant heating and by electrical resistance heating in the fish itself; but for various reasons these techniques have been unsuccessful. Although earlier work indicated that thawing by dielectric means would lead to local overheating, small-scale laboratory experiments at Torry have since shown that this technique may yet be the answer.

Since the time when the small-scale experiments were carried out, a pilot plant has been installed for experiments on a larger scale. This plant is fed by a 6 kW radio frequency generator operating over a frequency range of 36 to 40 Mc/s and has been used to determine the conditions under which blocks of frozen fish can be thawed uniformly. A study has been made of the way in which it might be possible to minimise the effects of slight inhomogeneities in the material and the field between the electrodes that give rise to progressively increasing local power absorption, known as "run-away heating."

It has been concluded from these investigations that batch thawing is not practicable on a large scale. However, it has been found that run-away heating can be avoided when fish is run continuously between the electrodes. Although under these conditions there appears to exist a certain critical power density above which run-away heating occurs, this value is found to be quite constant for any given type of fish.

The critical power density for blocks of herring is about three times that for white fish; and under the operating conditions of the pilot plant, herring can be thawed in about five minutes and white fish in 15 minutes, independently of thickness. By comparison, thawing by thermal conduction under industrial conditions, can take as long as 24 hours.

Work is still in progress at Torry on the thawing of sea-frozen blocks of whole fish, which, because of their somewhat irregular shape, are more difficult to thaw uniformly. At present, fish can be separated and almost completely thawed in about 75 minutes at 15·6° to 18·3° C. The time required to thaw comparable blocks in air under controlled conditions is 18 hours.

The amount of radio frequency energy absorbed in thawing has been found to correspond fairly well to the enthalpy change obtained from calorimetric determinations, so that the energy is efficiently utilised. The cost of commercially available plant for this work is comparable with that of conventional freezing plant of the same capacity, and the overall cost of thawing is about one-third that of freezing. Although no systematic work has yet been carried out with other foods, the signs are that this method need not be limited to fish alone.

Preparation Room

COMMENTS have been made recently by local authorities that many modern houses are being built with too small kitchens. Since even the most reluctant tin-opening housewife has to spend a considerable amount of her working day in this preparation room, the comment seems a fair one. For those for whom cooking is an art and a delight, then obviously space to work and space for storage are essential.

The larger illustration shows part of a kitchen equipped with Hygena standard units. Many other makes are on the market. A simple flow arrangement can make the work considerably easier and can also conserve space where this is at a premium. The example shows how the flow can be directed to a serving hatch, but the cooker is not included in this view. Avoidance of different levels of working surface is an obvious precaution to bear in mind in all schemes of this kind. And a well chosen height, suited to the housewife concerned, is essential if she is not to be knocked out by fatigue after a day's work.

The development of the "divided" cooker—with the oven, hot plates, and grill as three separate units—extends the possibilities for layout. Raising the oven to bench level removes some of the strain of lifting hot and heavy items, and particularly reduces the risk of spilling boiling fat. There is no technical reason why the components of a cooker should not be split in this way, but practically they should be arranged with an eye to the wiring or piping required as well as to the labour saving aspect.

The possibilities of electricity in the kitchen are being presented at the Food Fair (Olympia, London, 1 to 17 September) where an all-electric kitchen is on show, by the Electrical Development Association. All the items in the kitchen are being presented as prizes to daily winners in a song contest. Refrigeration, food preparation, cooking and dishwashing have halls of their own alongside.

To balance the picture, the Gas Council are showing 12 all-gas kitchens, each in the style of a different country with national dishes being prepared by cooks wearing national costume. In more than one of the kitchens is the Cannon A133 cooker, which combines gas and electricity in that the heating is by gas and the eyelevel spit is rotated by an electric motor. The combination might well be carried further—the oven could be electrically heated, thereby avoiding the need for a flue, and the boiling rings could be gas heated with the simplicity of control for simmering.

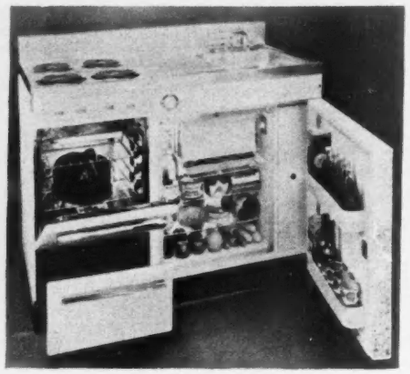
In the small flat and even more in the one room flatlet, a large kitchen area is an impossibility. Yet equally nice meals should be available. The question is becoming more urgent as 25 per cent of council houses and flats are now being built with only one bedroom. From abroad (where traditionally cooking and food are so much more important) comes the Compacta unit shown in the smaller illustration. With a length of 4 ft and a depth of 2 ft, it combines a cooker, refrigerator and sink. It is arranged for connecting to either gas or electrical supplies.

The cooker has four boiling rings, with quick heat burners in the gas model and 1·25 kW high-speed elements in the electric version, push button operated. The oven elements are rated at 5 kW and are under automatic heat control. Both models will take a large turkey in the oven which can bake and broil at the same time. The door is the modern drop type and below is a compartment for warming plates and similar duties. Bottled gas, town's gas, or natural gas can be used, there being a valve on the inlet which is adjustable.

The refrigerator has a capacity of more than 5 cu. ft with a large horizontal 25 lb freezer. There are double inner door shelves giving a total shelf area of approximately 8½ sq. ft. Insulation between the units is hermetically sealed glass fibre and there are insulating gaskets on the doors of both oven and refrigerator. It is claimed that there is no interaction of the two units.

The sink measures 1 ft 4 in by 1 ft 6 in and is made in stainless steel or porcelain, complete with the draining board.

The Compacta units are being imported by General Trade Equipment Limited, 82 Seymour Place, London, W1, and the address of Hygena Limited is Kirkby Industrial Estate, Kirkby, Liverpool.



(Above) The Compacta is designed for the smallest kitchen. It includes cooker, refrigerator and sink, in a length of 4 ft.

(Left) Standard units like these by Hygena can be used to make a smooth layout in the kitchen in the minimum of space and demanding the minimum of labour.

ENGINEERING

Published every Friday by Engineering Ltd. at 36 Bedford Street, London, WC2, England.

Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

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Subscription Rates
One year, inland and abroad £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6d all countries. Single copies 2*s* 7*d* post paid.

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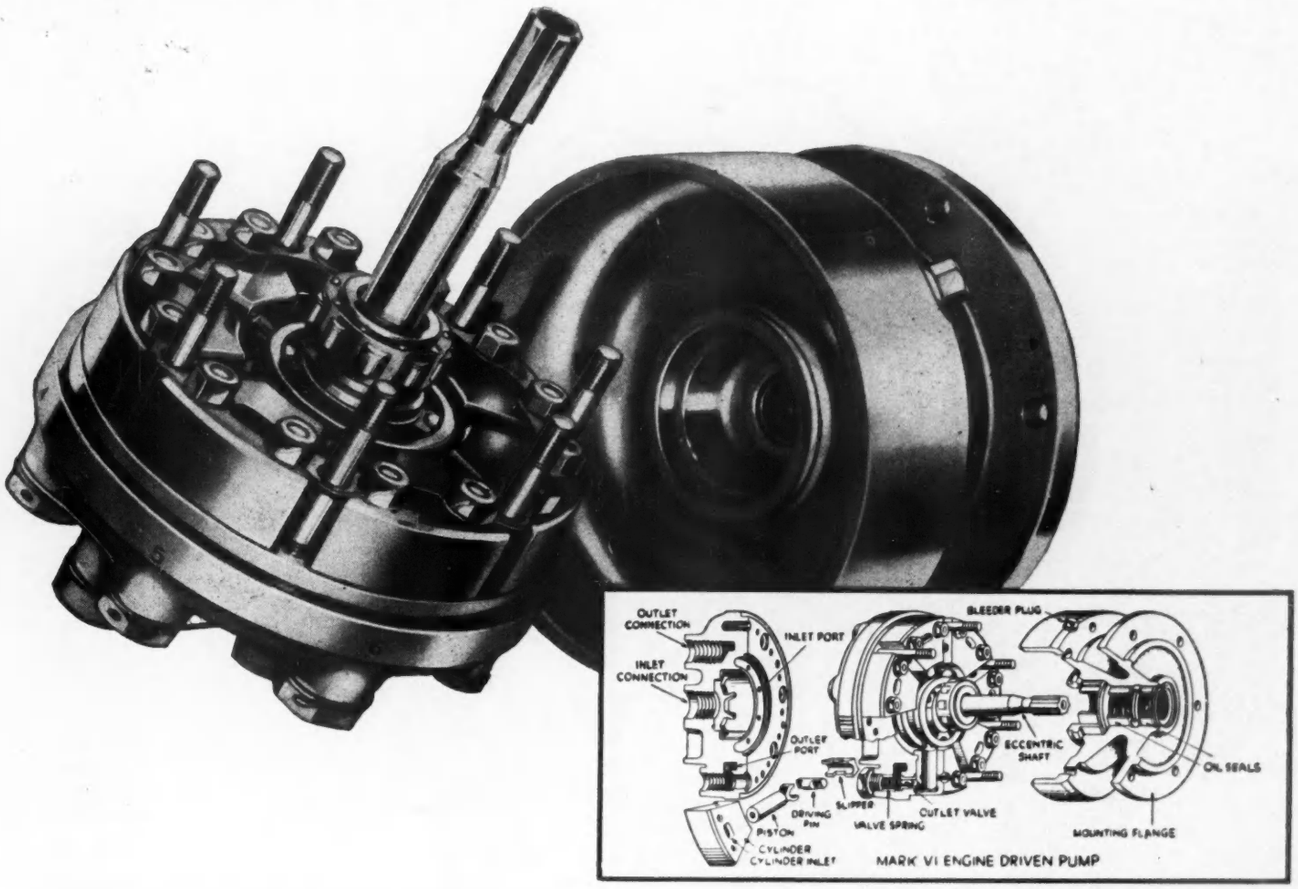

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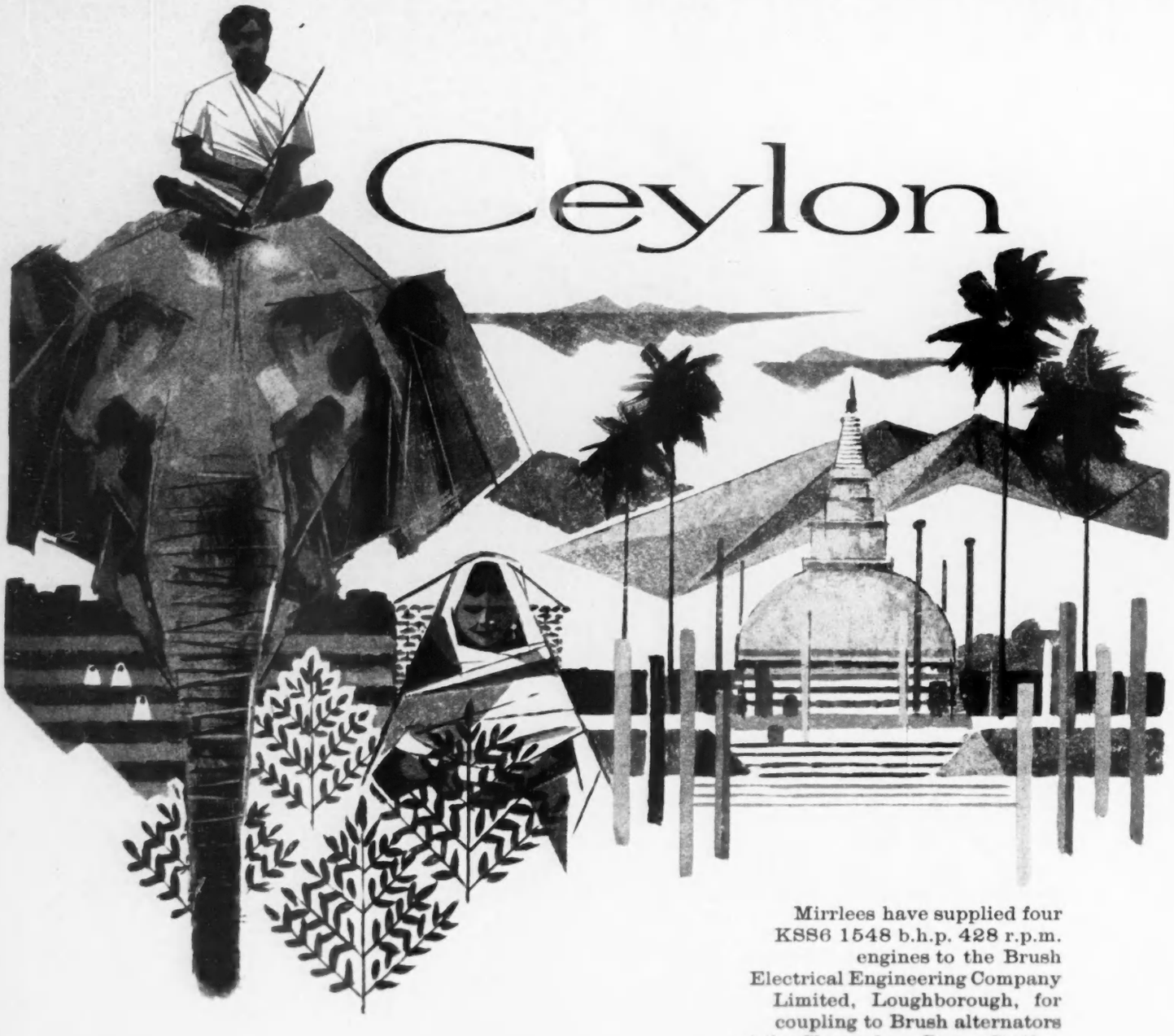

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Hydroponics Will Feed Men on the Moon

As man's environment is forced to yield ever greater quantities of food, cultivation must become increasingly mechanised

By G. V. E. Thompson, B.Sc., B.Sc.(Eng.), A.R.C.S., F.R.I.C.

replenished with the sewage to which will be added any necessary trace elements. The absence

impossible to turn back on voyages of this kind, the cycle will have to be 100 per cent successful:

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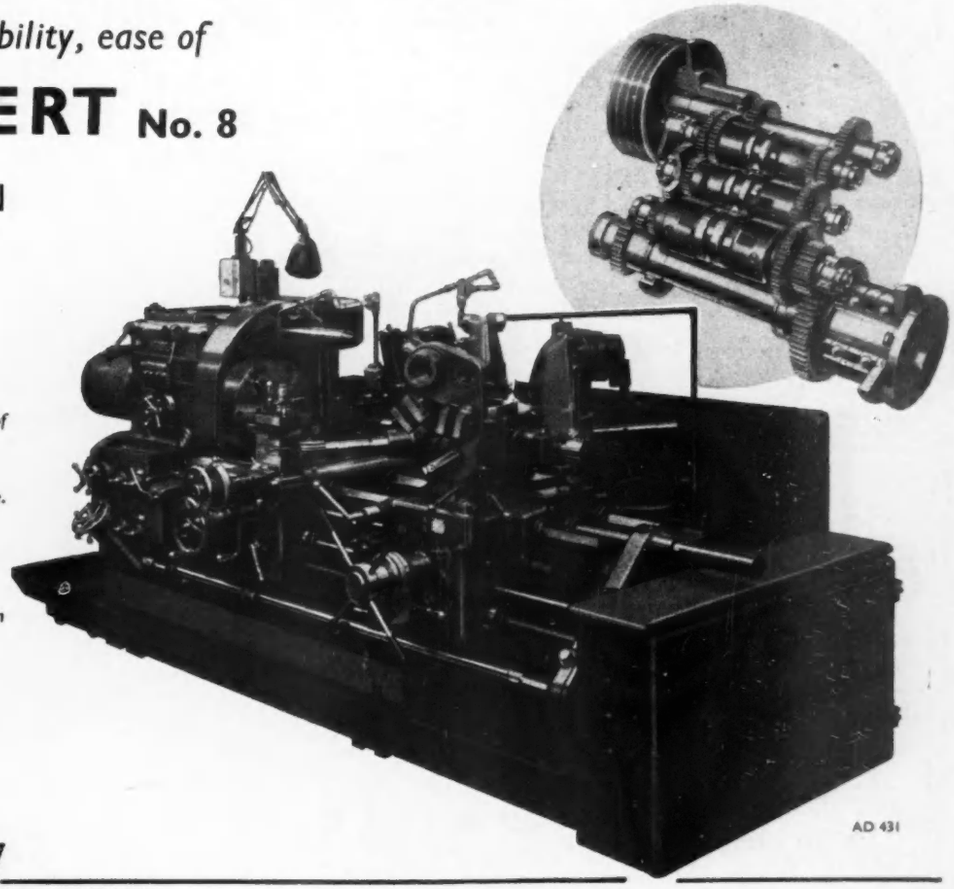

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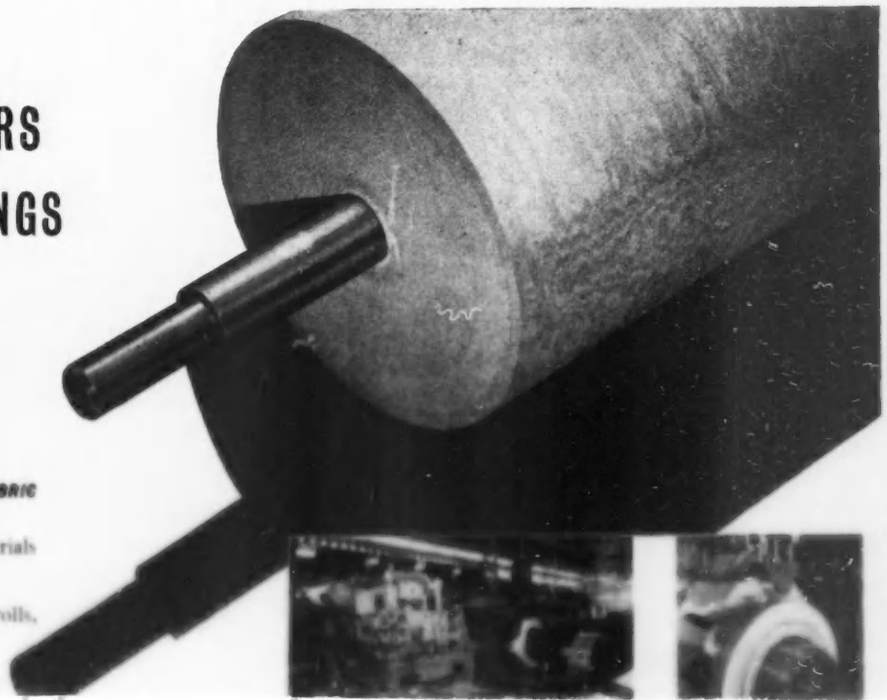

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Engineers familiar with designing materials-handling equipment and processing equipment meet a new challenge in food manufacturing. Not only must the equipment operate efficiently from an engineering point of view but it must also produce food that is appetising. A straightforward engineering approach to the design of

have been carried out on manufacturers' premises. The drying stoves, which measured up to 72 ft long by 42 ft wide by 11 ft high, were instrumented to discover the distributions of temperatures, relative humidities, and air velocities; thermocouples were also inserted into certain sweets. Further experiments were carried out

Hydroponics will Feed Men on the Moon

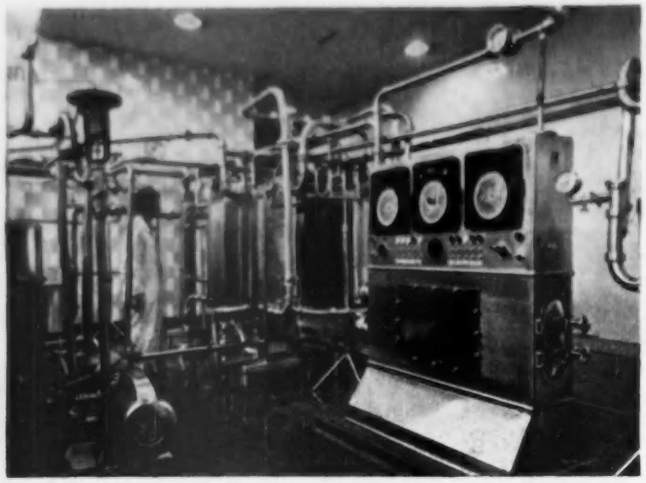
As man's environment is forced to yield ever greater quantities of food, cultivation must become increasingly mechanised and systematic. Engineering will finally usurp the functions of the farmer when men, establishing themselves upon the barren Moon, begin to grow their food in process plants.

By G. V. E. Thompson, B.Sc., B.Sc.(Eng.), A.R.C.S., F.R.I.C.

The dawn of civilisation on Earth was closely linked with the beginning of agriculture. Civilisation in turn made man less dependent upon his immediate environment so that with the development of engineering he could venture into areas hitherto inaccessible. He could reach even the sea bed and the skies. His explorations were often prompted by the need of growing populations to satisfy their ever accumulating appetites. Engineering is now being pressed into service to increase the regions under cultivation, and if world population continues to rise exponentially, it will ultimately be necessary to farm the bottom of the sea, a practice already within sight. At the same time a premonitory consciousness of Earth's inadequacy may send man tentatively into space. Again he will be called upon to secure his food supplies, perhaps by growing food in tanks under controlled conditions. With the advent of "soilless cultivation" in chemical solutions—a technique known as hydroponics—biochemical engineers will begin to play a major part in food production.

Within the next decade man will commence operations upon his second world—the Moon. The new lunar civilisation will be dependent at first upon supplies of food brought from Earth, but it is economically and biologically desirable that native agriculture should be established as soon as possible. It will require about 200 tons of propellents to transport one ton of food and drink to the Moon, and the consumption of that ton of food will eventually yield one ton of biological waste products. On the Earth these waste products would find their way—via a series of chains and cycles—back into food production. If the lunar population grows steadily, as is to be expected, there will come a time when some form of recycling becomes necessary there also.

With no seas, no atmosphere and no soil, ordinary methods of farming are out of the question and hydroponics is most likely to be used. Tanks, pipelines, pumps and similar equipment would be obtained by cannibalisation of supply rockets; the nutrient solutions would be replenished with the sewage to which will be added any necessary trace elements. The absence of an atmosphere makes it imperative for the system to be housed in a sealed building. It has been suggested that this should be built or roofed in transparent plastic to admit sunlight to the growing plants, but there is no advantage in doing so. On the Moon there are roughly fourteen terrestrial days of sunlight followed by a similar period of night. Artificial light would have to be supplied during the lunar night, and therefore might just as well be used continually.



The control of biological processes by engineering methods is already well established. The APV continuous ice-cream mix pasteurisation plant at the Lyons Maid factory is required to hold the mix within close temperature limits for a critical period of time, thereby destroying heat-allergic organisms without encouraging thermophilic ones to multiply. Equipment of this kind perhaps foreshadows the plant that may eventually be used for hydroponics.

This procedure has all the advantages of continuous over batch processes and avoids the need to provide for variations in irradiation throughout the long lunar day (the noon radiation would be excessive as the screening effect of an atmosphere is absent).

The plants grown in this way could be eaten directly, thus reducing the biological cycle to its absolute essentials. It would be preferable, however, to feed them to small animals (the battery hen is an obvious choice) to make the diet both more palatable and varied.

Hydroponics will be even more essential during space voyages to other planets. Even with the nearest planets, Mars and Venus, the round trip would occupy a couple of years or so. No supplies could be ferried out to the vessel during this period, and take-off mass must be reduced to the absolute minimum. A closed biological cycle will have to be employed. As it is impossible to turn back on voyages of this kind, the cycle will have to be 100 per cent successful: crop failures, pests, or adverse "weather" conditions would leave the crew no hope of survival.

Practical work on this type of system has been undertaken in the United States for several years past (and probably also in the Soviet Union, for Russia's entire space programme is directed towards getting *man* into space ahead of other nations; instrument-carrying vehicles are tools only).

Algae have already been chosen as the most suitable plant, and investigations have been made into the most suitable types of algae, long-term behaviour of the system, methods of rendering the plant palatable, and so on.

It may seem surprising that this work is now in progress although man himself has not yet ventured even 100 miles out into space, but the problem of keeping men alive on a voyage to and from Mars is more difficult than that of building a vehicle to take them there. It will require many years' work to solve it, but the problem must be solved before design of the vehicle begins.

Agriculture has developed very slowly during the last few million years, but progress has been rapid since engineering methods were applied. Hydroponics is largely a matter of engineering; space feeding will be entirely so—it would be hopeless to depend upon "green fingers."

Controlled Farming by Lamplight Underground

Farms of the future may go underground where temperature, weather conditions, plant diseases, nutrition and lighting can be accurately controlled regardless of the season or weather. According to Mr. Robert L. Zahour, manager of application engineering for the Westinghouse lamp division, such foods as bananas, oranges, grapefruit, lemons and other items which are now raised almost solely in tropical areas, could be grown in entirely different climates—possibly in Alaska or Siberia. He stated that recently the Beltsville, Maryland, and Rutgers, New Jersey, agricultural experimental stations in the United States have discovered a narrow band of rays in light from incandescent bulbs and fluorescent lamps, which are largely responsible for plant growth. This research could lead, he believed, to the development of light sources which emit sizeable quantities of growth-stimulating rays.

Experiments in the use of lamps for stimulating growth in greenhouses had been conducted since the late 1800's and in 1937, Dr. A. M. Porter from the University of Connecticut and Mr. Zahour tried ordinary 25 watt household bulbs for heating hotbeds. The successful results from three consecutive seasons indicated that it was cheaper to use bulbs for this application than soil heating cable or active manure. In 1942, Professor A. B. Strand and Professor G. E. Zerfoss, from the University of Tennessee Agricultural Experiment Station, repeated the bulb method of heating hotbeds, and arrived at the same conclusions.

In 1949, Mr. Zahour and Dr. O. W. Davidson, plant research specialist at Rutgers University, planned a long term project in an "underground" greenhouse from which all daylight was excluded, to determine how much actual artificial light was needed to maintain house plants in healthy condition. After several years of research, Dr. Davidson discovered several plants which would grow satisfactorily under light bulbs or fluorescent lamps corresponding in lighting level to those used in offices and homes. These lighting intensities are about one-hundredth of noon-day sunlight.

African violets have a definite range of lighting levels to keep them blossoming continuously, Mr. Zahour disclosed. This range is between one-tenth and one-twentieth of noon-day sunlight. Outside of this range, African violets will maintain their foliage but rarely blossom. Like fertiliser and moisture in the soil, light feeds the plants. Light rays are converted into plant foods by the chlorophyl in the foliage. A plant can starve for lack of light, or it can get "stuffed" if it receives too much.

Engineers familiar with designing materials-handling equipment and processing equipment meet a new challenge in food manufacturing. Not only must the equipment operate efficiently from an engineering point of view but it must also produce food that is appetising. A straightforward engineering approach to the design of a machine for cooling pies, for example, might adversely affect their taste or character. And the physical properties of the foods can often add further complications. The viscosity of molten chocolate, for example, is more difficult to characterise than that of fuel oils, and consequently pump and piping is more complex.

A certain number of engineering problems of this sort are handled by the British Food Manufacturing Industries Research Association at Leatherhead. Though the professionally qualified staff there are either chemists, physicists or bacteriologists, the practical nature of the assocation's services makes engineering considerations important.

Research at the Leatherhead laboratories covers a wide field, including chromatographic work, biochemical and microbiological research, as well as many investigations into specific foods and processes, including bakery materials, oils and fats, jam, pickles and sauces, meat and fish, sugar confectionery, and cocoa and chocolate. The engineering aspects are best seen by considering a number of investigations carried out in recent years.

The drying of sugar confectionery is one of the topics currently being studied. Much confectionery is manufactured by deposition in impressions made in powdered starch in large flat trays. The trays are placed in stacks in heated rooms—generally referred to as stoves. Transfer of moisture from the sweet to the starch and from the starch to the atmosphere is being investigated at the laboratory. Changes of weight in the starch and in the sweets are determined while the material is losing moisture in an atmosphere of any desired humidity and at temperatures up to 70° C.

To obtain information on the conditions that actually exist in stoves, a number of studies have been carried out on manufacturers' premises. The drying stoves, which measured up to 72 ft long by 42 ft wide by 11 ft high, were instrumented to discover the distributions of temperatures, relative humidities, and air velocities; thermocouples were also inserted into certain sweets. Further experiments were carried out to discover the relationship between stoving conditions and the rate of drying of the sweets in starch. Conditions were found to vary widely at different locations within a given stove, and several modifications to stove design to produce more even temperature distributions have been proposed.

The general design and installation of machinery from the point of view of control of insect pests have been the subject of two reports by the association. Requests for translation of these into French, German, and Italian have been received in the past year. The growing use of electronics devices, such as metal detectors and automatic controls, is increasing but such equipment by its very nature is not easily cleaned.

Other investigations have been concerned with the physical properties of foods. Studies have been made of the piping properties of jellies and the extrudability of fats. An instrument has been developed which automatically records the thrust required to force a plastic material—margarine, say—through a small orifice at a uniform speed. The thrust varies throughout the extrusion of the sample and the lowest value has been found to correlate very closely with subjective assessments of "firmness" of the fat and to correlate inversely with subjective assessments of "spreadability." Since its development, an instrument, known as the FIRA/NIRD Extruder, has found application outside the food industry, notably in the evaluation of plastic explosives.

Investigations on the viscosity of molten chocolate have given support to a new rheological relationship for it. Earlier work suggested that molten chocolate exhibited Bingham body behaviour. That is, a definite minimum stress (termed the yield value) had to be applied before any flow took place; after flow started a rate of shear was produced proportional to the extra stress applied. It turns out, however, that chocolate behaves in a more complex way. The shear rate and stress are not so simply related; particularly just above the yield value. Unfortunately, it is just in this region that the viscous behaviour of molten chocolate is of great importance, for it is under such conditions that chocolate flows over centres in an enrober. At present, work is under way in connection with investigations into the effects of composition and processing on viscosity to find a useful method of specifying the behaviour of chocolate when molten. For this work an instrument has been developed which measures viscosity at very low rates of shear.

An experimental cooling tunnel used for determining the rate of cooling of meat pies.

Handling and Transporting Frozen Fish

Between them, the Department of Scientific and Industrial Research and the Agricultural Research Council have a number of laboratories, conducting research into almost every conceivable aspect of food. Quality, production, pest infestation, storage, handling and transportation of all types of food, are just a few of the topics dealt with by these laora t ories.

One of the best, and oldest established of these laboratories is the Torry Research Station, at Aberdeen, which is concerned solely with fish, particularly its preservation and storage.

Handling and transporting frozen fish comes high on the list of priority at Torry, since these are among the main factors governing both quality and wastage. A number of theoretical and experimental studies have been made of the rate of heating packages of frozen fish exposed to normal room temperature. Typical of the findings of this type of work has been the discovery and analysis of the freezing/thawing relationship of fish, knowledge of which has enabled improvements to be made in fish handling, right from the trawler to the shop.

The thermal conductivity of thawed fish flesh has been found to be about one-third of the frozen flesh and in consequence, under practical conditions, the time required for thawing by thermal conduction is about three times as long as that required for freezing. Under industrial conditions lengthy thawing periods can be a serious embarrassment because of the large amount of floor space and handling required. Furthermore, it is known that fish must be individually removed from composite blocks as they thaw and then immediately chilled or processed, if damage to texture is to be avoided.

In view of this and the steadily increasing large-scale further processing of cold stored fish, frozen in blocks on shore or at sea, the need for much speedier thawing has become urgent. In the past, attempts have been made to thaw fish by radiant heating and by electrical resistance heating in the fish itself; but for various reasons these techniques have been unsuccessful. Although earlier work indicated that thawing by dielectric means would lead to local overheating, small-scale laboratory experiments at Torry have since shown that this technique may yet be the answer.

Since the time when the small-scale experiments were carried out, a pilot plant has been installed for experiments on a larger scale. This plant is fed by a 6 kW radio frequency generator operating over a frequency range of 36 to 40 Mc/s and has been used to determine the conditions under which blocks of frozen fish can be thawed uniformly. A study has been made of the way in which it might be possible to minimise the effects of slight inhomogeneities in the material and the field between the electrodes that give rise to progressively increasing local power absorption, known as "run-away heating."

It has been concluded from these investigations that batch thawing is not practicable on a large scale. However, it has been found that run-away heating can be avoided when fish is run continuously between the electrodes. Although under these conditions there appears to exist a certain critical power density above which run-away heating occurs, this value is found to be quite constant for any given type of fish.

The critical power density for blocks of herring is about three times that for white fish; and under the operating conditions of the pilot plant, herring can be thawed in about five minutes and white fish in 15 minutes, independently of thickness. By comparison, thawing by thermal conduction under industrial conditions, can take as long as 24 hours.

Work is still in progress at Torry on the thawing of sea-frozen blocks of whole fish, which, because of their somewhat irregular shape, are more difficult to thaw uniformly. At present, fish can be separated and almost completely thawed in about 75 minutes at 15·6° to 18·3° C. The time required to thaw comparable blocks in air under controlled conditions is 18 hours.

The amount of radio frequency energy absorbed in thawing has been found to correspond fairly well to the enthalpy change obtained from calorimetric determinations, so that the energy is efficiently utilised. The cost of commercially available plant for this work is comparable with that of conventional freezing plant of the same capacity, and the overall cost of thawing is about one-third that of freezing. Although no systematic work has yet been carried out with other foods, the signs are that this method need not be limited to fish alone.

Preparation Room

Comments have been made recently by local authorities that many modern houses are being built with too small kitchens. Since even the most reluctant tin-opening housewife has to spend a considerable amount of her working day in this preparation room, the comment seems a fair one. For those for whom cooking is an art and a delight, then obviously space to work and space for storage are essential.

The larger illustration shows part of a kitchen equipped with Hygena standard units. Many other makes are on the market. A simple flow arrangement can make the work considerably easier and can also conserve space where this is at a premium. The example shows how the flow can be directed to a serving hatch, but the cooker is not included in this view. Avoidance of different levels of working surface is an obvious precaution to bear in mind in all schemes of this kind. And a well chosen height, suited to the housewife concerned, is essential if she is not to be knocked out by fatigue after a day's work.

The development of the " divided " cooker—with the oven, hot plates, and grill as three separate units—extends the possibilities for layout. Raising the oven to bench level removes some of the strain of lifting hot and heavy items, and particularly reduces the risk of spilling boiling fat. There is no technical reason why the components of a cooker should not be split in this way, but practically they should be arranged with an eye to the wiring or piping required as well as to the labour saving aspect.

The possibilities of electricity in the kitchen are being presented at the Food Fair (Olympia, London, 1 to 17 September) where an all-electric kitchen is on show, by the Electrical Development Association. All the items in the kitchen are being presented as prizes to daily winners in a song contest. Refrigeration, food preparation, cooking and dishwashing have halls of their own alongside.

To balance the picture, the Gas Council are showing 12 all-gas kitchens, each in the style of a different country with national dishes being prepared by cooks wearing national costume. In more than one of the kitchens is the Cannon A133 cooker, which combines gas and electricity in that the heating is by gas and the eyelevel spit is rotated by an electric motor. The combination might well be carried further—the oven could be electrically heated, thereby avoiding the need for a flue, and the boiling rings could be gas heated with the simplicity of control for simmering.

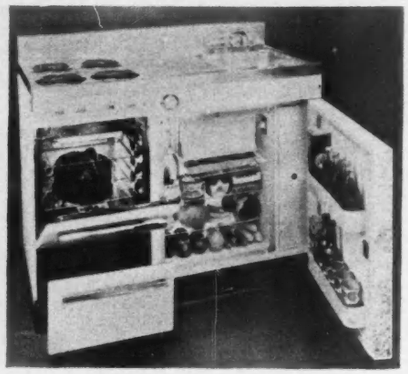
In the small flat and even more in the one room flatlet, a large kitchen area is an impossibility. Yet equally nice meals should be available. The question is becoming more urgent as 25 per cent of council houses and flats are now being built with only one bedroom. From abroad (where traditionally cooking and food are so much more important) comes the Compacta unit shown in the smaller illustration. With a length of 4 ft and a depth of 2 ft, it combines a cooker, refrigerator and sink. It is arranged for connecting to either gas or electrical supplies.

The cooker has four boiling rings, with quick heat burners in the gas model and 1·25 kW high-speed elements in the electric version, push button operated. The oven elements are rated at 5 kW and are under automatic heat control. Both models will take a large turkey in the oven which can bake and broil at the same time. The door is the modern drop type and below is a compartment for warming plates and similar duties. Bottled gas, town's gas, or natural gas can be used, there being a valve on the inlet which is adjustable.

The refrigerator has a capacity of more than 5 cu. ft with a large horizontal 25 lb freezer. There are double inner door shelves giving a total shelf area of approximately 8½ sq. ft. Insulation between the units is hermetically sealed glass fibre and there are insulating gaskets on the doors of both oven and refrigerator. It is claimed that there is no interaction of the two units.

The sink measures 1 ft 4 in by 1 ft 6 in and is made in stainless steel or porcelain, complete with the draining board.

The Compacta units are being imported by General Trade Equipment Limited, 82 Seymour Place, London, W1, and the address of Hygena Limited is Kirkby Industrial Estate, Kirkby, Liverpool.



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(Left) Standard units like these by Hygena can be used to make a smooth layout in the kitchen in the minimum of space and demanding the minimum of labour.

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Published every Friday by Engineering Ltd. at 36 Bedford Street, London, WC2, England.

Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

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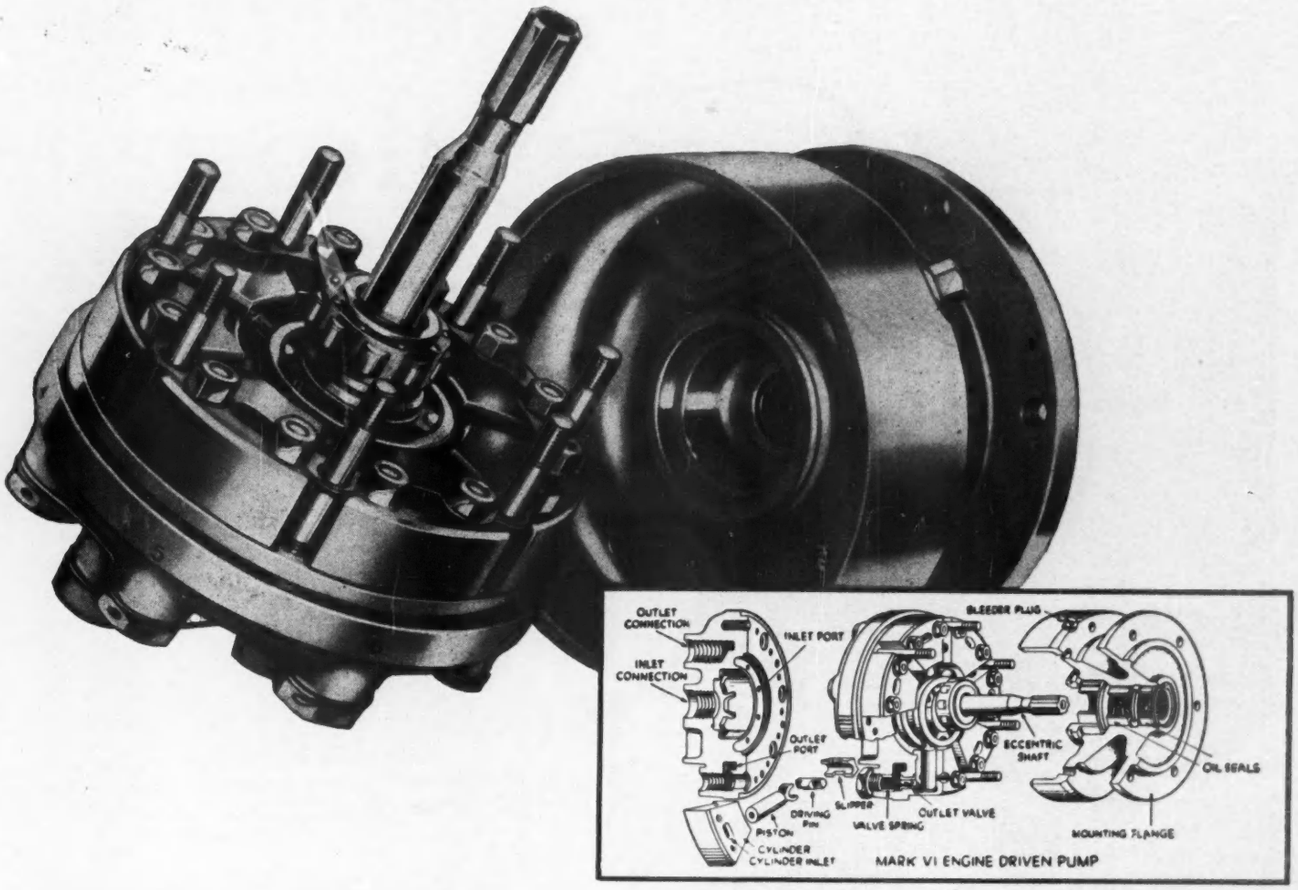
NICKEL ALLOY STEELS



ensure reliability in reciprocating units

Lockheed hydraulic pumps, made by the Automotive Products Company Ltd., Leamington, have a world-wide reputation for reliability in the aircraft industry. They are used to actuate flying controls, landing flaps, wheel brakes and undercarriages. Constructional materials are an important factor in achieving reliability in the normal 1000-hour period of operation during which, running at 3000 r.p.m., the plunger operates 174,000,000 times. To withstand the wear associated with reciprocating units, the three per cent nickel case-hardening steel 4S15 (En33) is specified for the cylinders.

TYPICAL CORE MECHANICAL PROPERTIES OF

EN 33

ARE GIVEN BELOW:

SIZE	HEAT TREATMENT	MAXIMUM STRESS t.s.i.	ELONGATION per cent	IZOD ft. lb.
1⅛" dia.	Oil quenched 860°C. Water quenched 770°C.	56·3	21·5	83
3" dia.	Oil quenched 860°C. Water quenched 760°C.	47·2	20	92

The benefits to be gained from the more highly alloyed case-hardening nickel steel, such as EN 33; EN 34; EN 36 and EN 39 include ease of heat-treatment, minimisation of processing distortion, and general reliability.

Please send for our publications entitled, 'The Mechanical Properties of Nickel Alloy Steels' and 'The Case Hardening of Nickel Alloy Steels'

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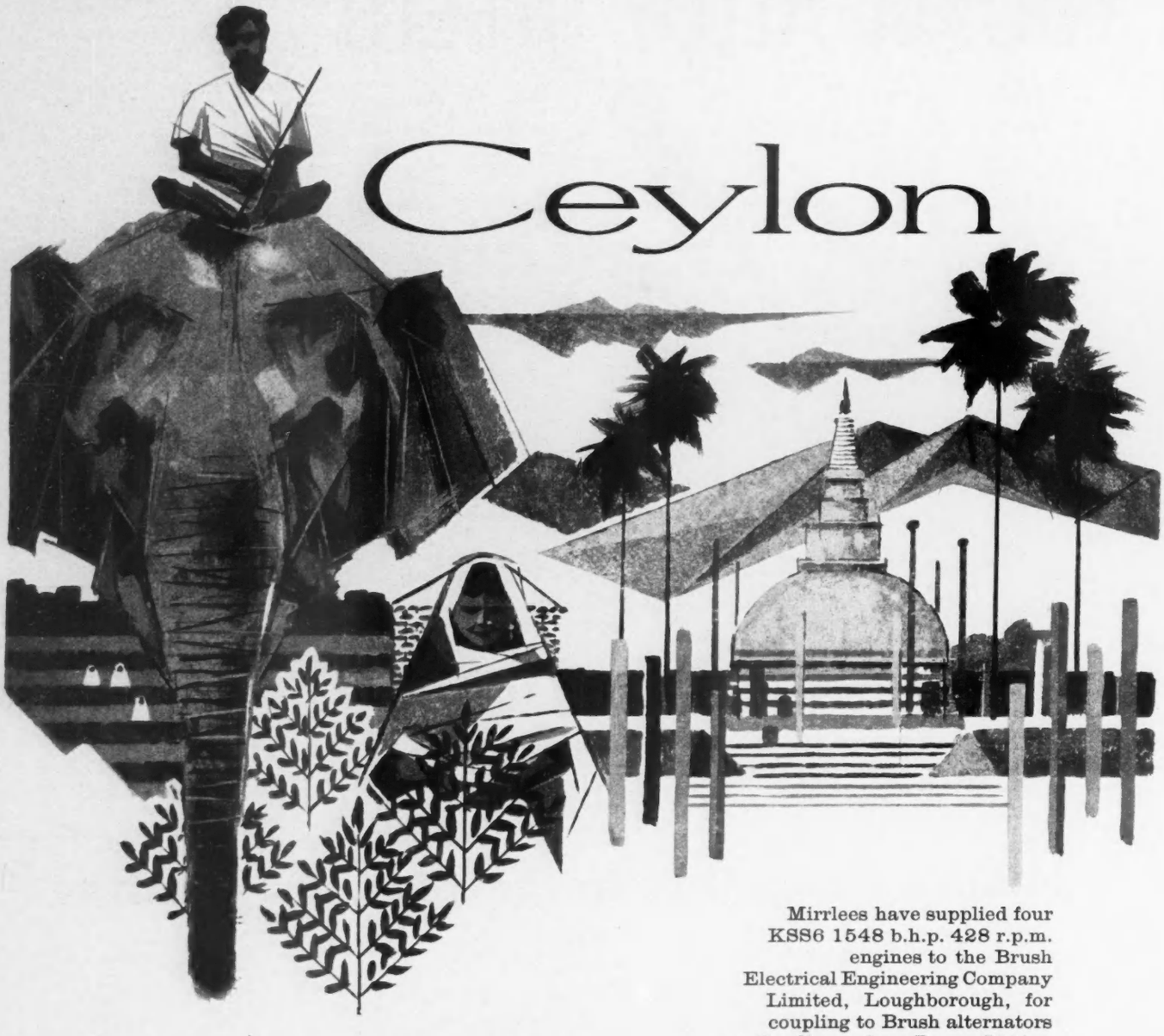
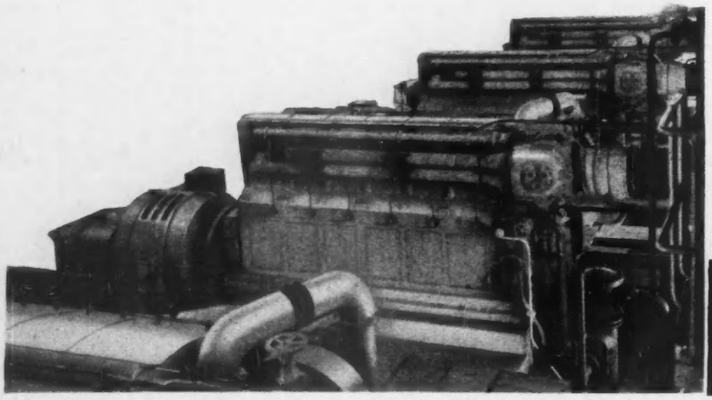
Mirrlees meets the world's power needs



Mirrlees have supplied four KS8S6 1548 b.h.p. 428 r.p.m. engines to the Brush Electrical Engineering Company Limited, Loughborough, for coupling to Brush alternators at the Chunnakam Power Station of the Ceylon Government Electrical Undertaking.

All major engine ancilliary equipment was supplied by Mirrlees whose engineers assisted in the installation and commissioning of the complete plant.

Our agents in this territory are Wm. Jacks & Co. (Ceylon) Limited, Colombo.



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every modern feature is incorporated to ensure high production, accuracy, durability, ease of operation on the **HERBERT No. 8**

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- *Maximum swing 20in., 11¾in. over cross slide.*
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- *15/5 h.p. motor.*
- *16 spindle speeds, 13 to 1,000 r.p.m.*
- *Power-operated Preoptive Headstock permits pre-selection of next speed whilst cutting.*
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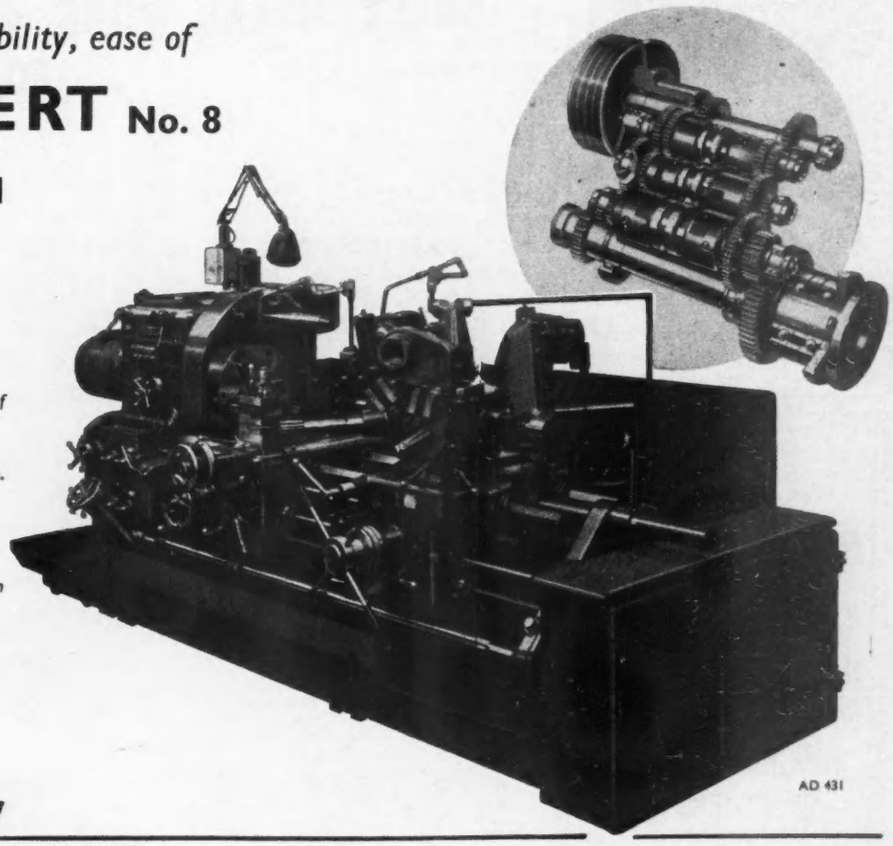

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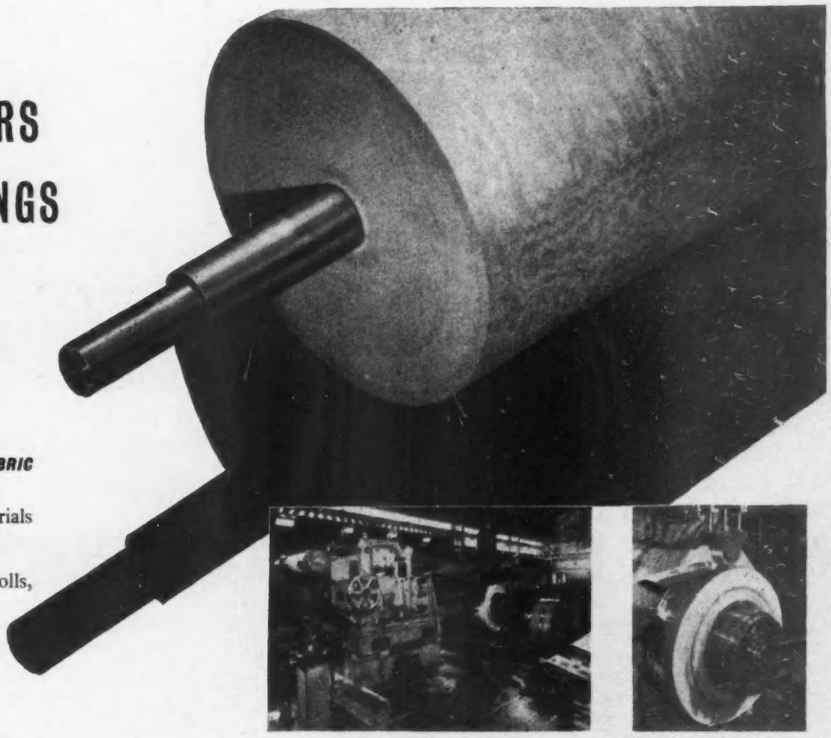

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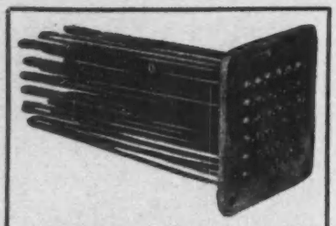

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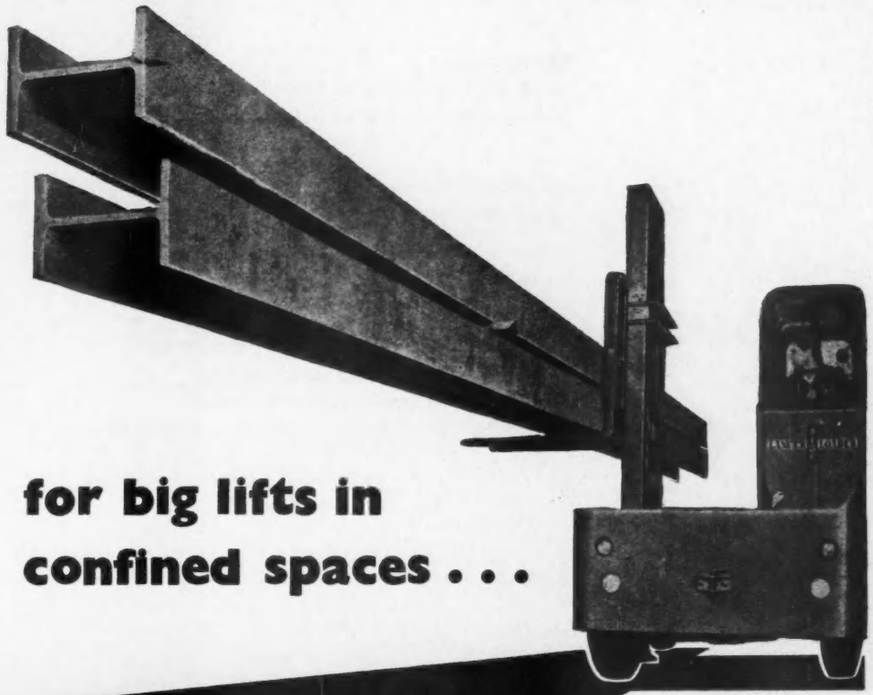

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Sideloader is the Trade Mark of Lancer Machinery Ltd.

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In the most efficient and reliable way

Because a LANCER SIDELOADER with one operator will stack, load and transport, releasing other hands for more productive work. With lift heights from 8ft. to 24ft. and ability to work in narrow gangways the LANCER makes the most of costly storage space. Loads are carried safely on the decks. Mechanical specification is superb providing the perfect machine for long, trouble free service, with control so light that operator fatigue is a thing of the past. Fast in operation and built with a really adequate safety margin. The engine is placed for stability and accessibility and service on the LANCER is so easy that your men will like doing it.

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Lift height 10-18 feet makes full use of storage space.

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WITH INDUSTRIAL TYPE ELECTRICAL MOTORS:

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SAVES *the cost of high starting torque motors.*

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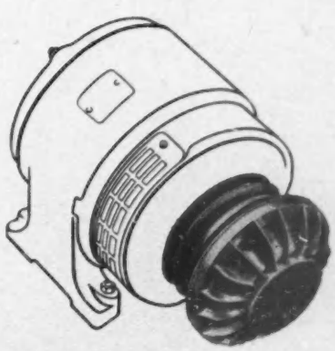

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For equipment
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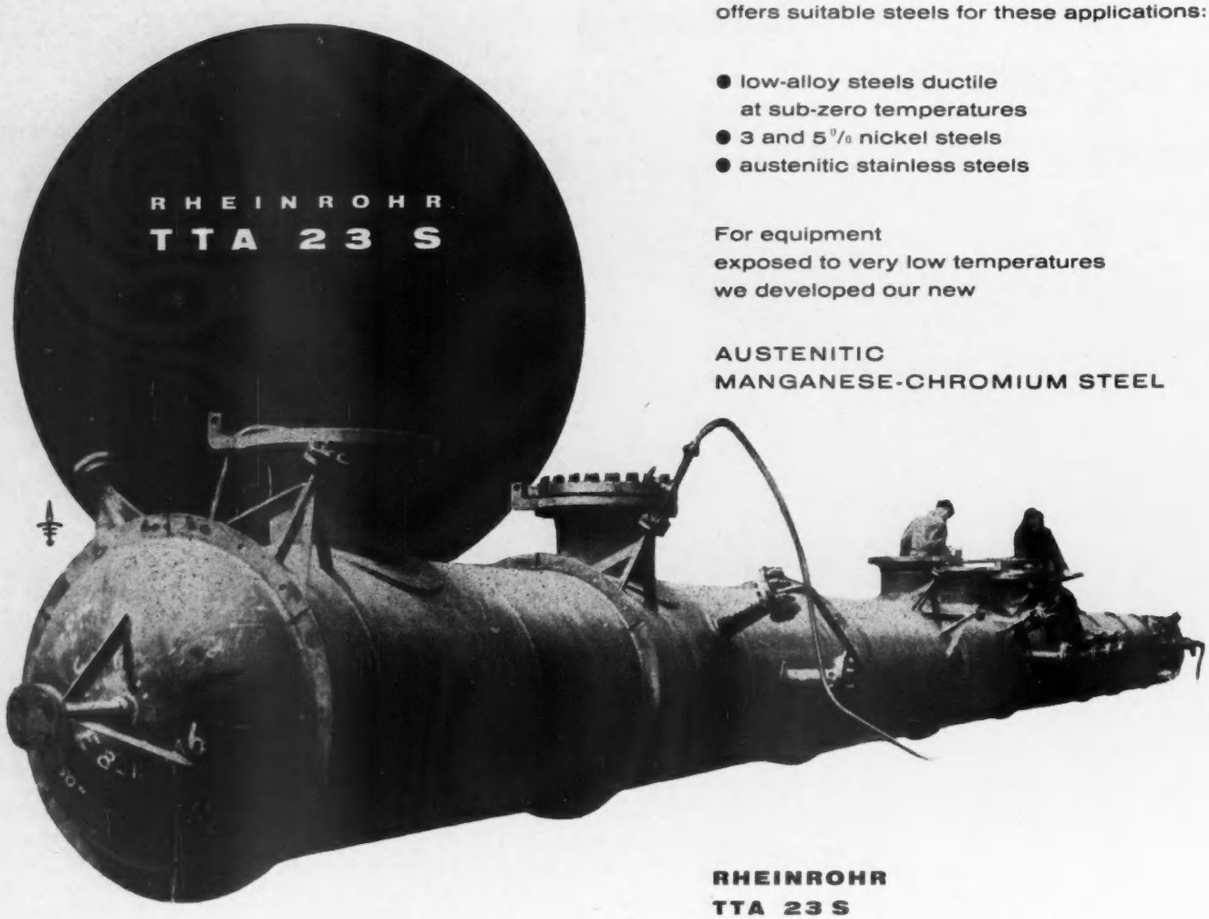

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of low-temperature plants
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and its favourable price.

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Mather & Platt

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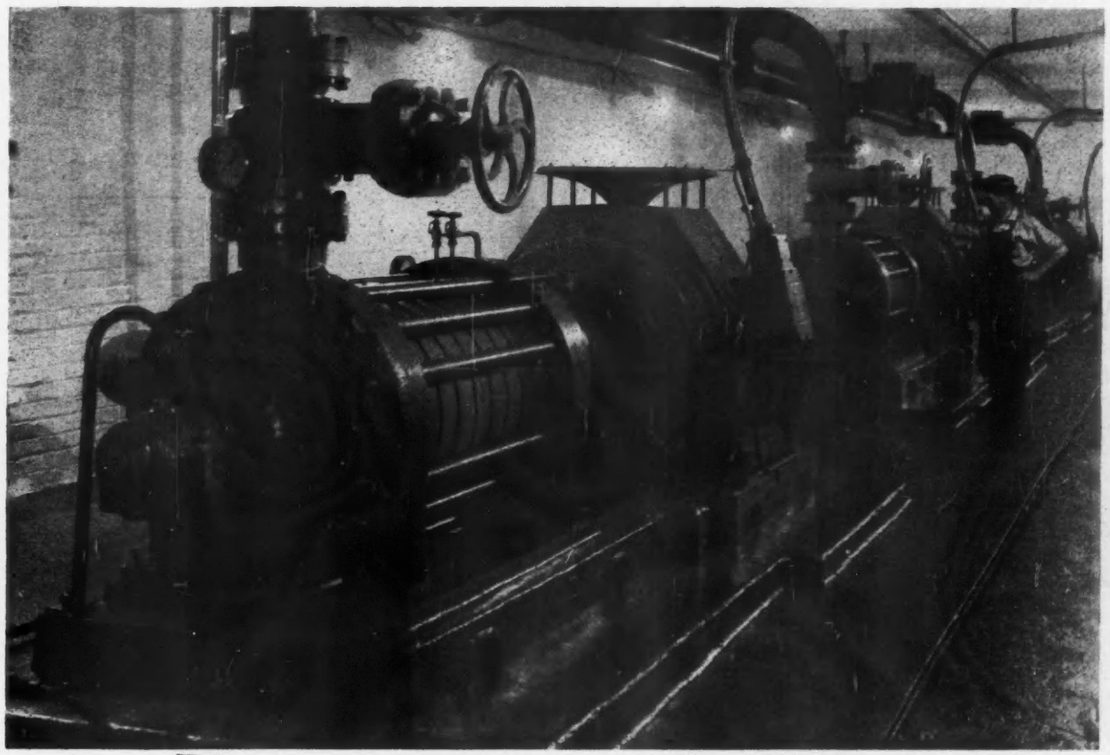

Mather & Platt electrically-driven pumping sets on drainage duty in a Scottish colliery. Each pump has a duty of 1000 g.p.m. against a 1550 ft. head and is driven by a 3 phase, 50 cycles, 3000/3300 v., induction motor. The motors are rated at 650 b.h.p., 1500/1480 r.p.m.

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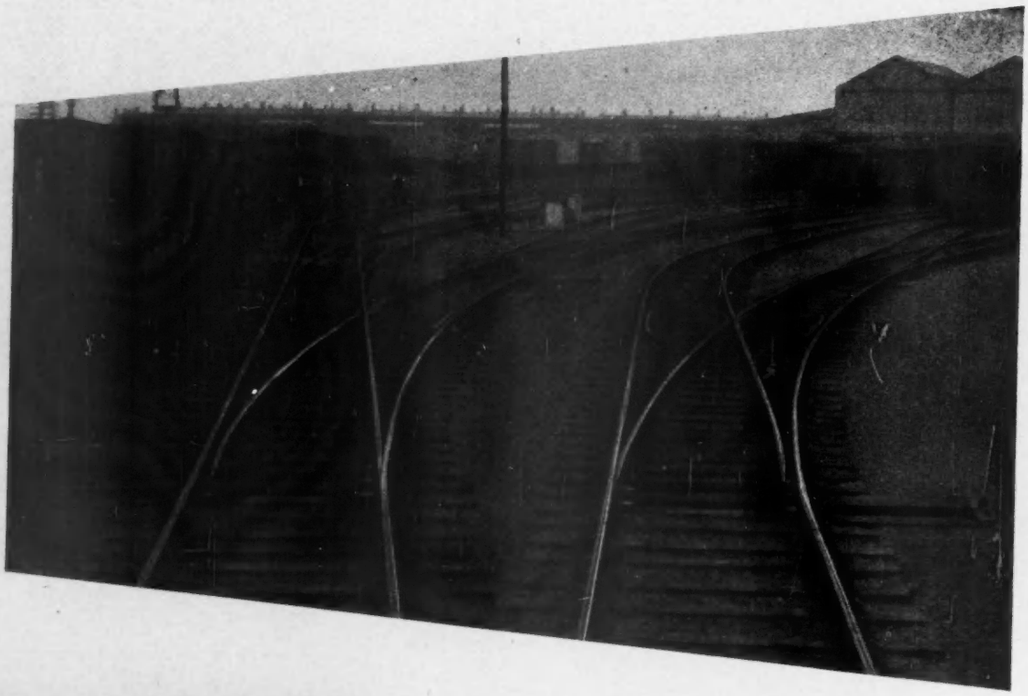

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AT CAMBOIS COLLIERY BLYTH

Wards have been laying industrial sidings for over sixty years, and in this specialised field hold an enviable reputation as consultants and contractors. The design, construction and maintenance are all part of the service, and large resources and skilled labour force enable the simultaneous execution of a number of contracts, irrespective of size and location.

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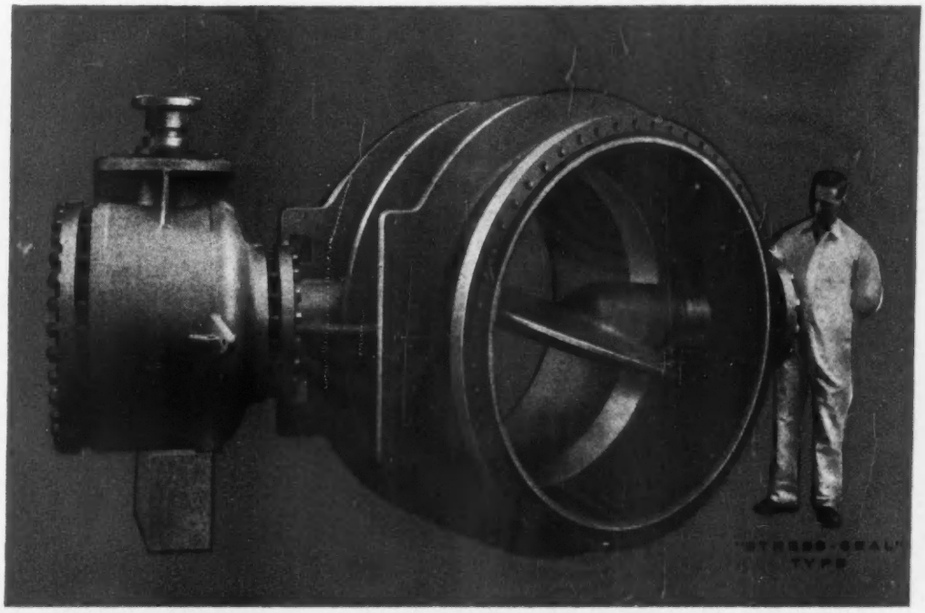

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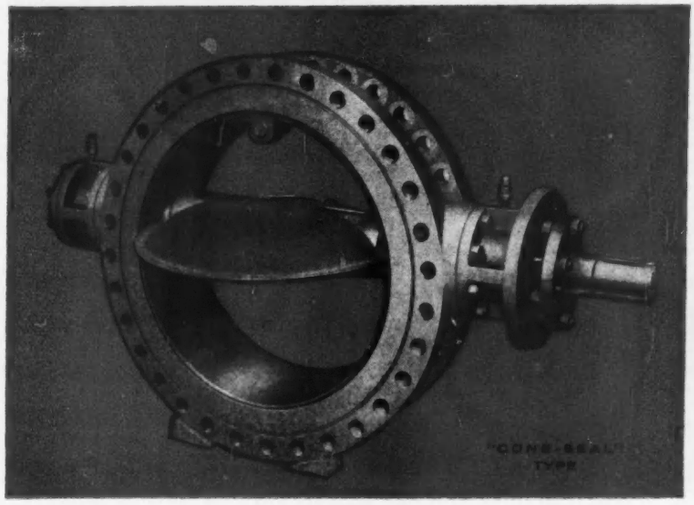

Specially developed for high temperature gas duct service, Blakeborough "Cone-Seal" and "Stress-Seal" Butterfly valves have aroused particular interest in the nuclear field. The "Cone-Seal" construction is applicable to sizes up to 42 in. bore; the "Stress-Seal" from 36 in. upwards. Both give tight closure, or shut-off to very fine leakage tolerances, even under severe thermal shock conditions. They are being supplied for main duct isolating duty on the following power reactors :-

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TOKAI MURA	"Stress-Seal" type. Eight 66 in. bore. Design conditions : 230 psig. and 797° F.
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TRAWSFYNYDD	Twelve 66 in. bore. Main gas duct throttle service. Twelve 42 in. bore. By-pass service. Also : Throttle type butterfly valves (without shut-off), as at present in hand.

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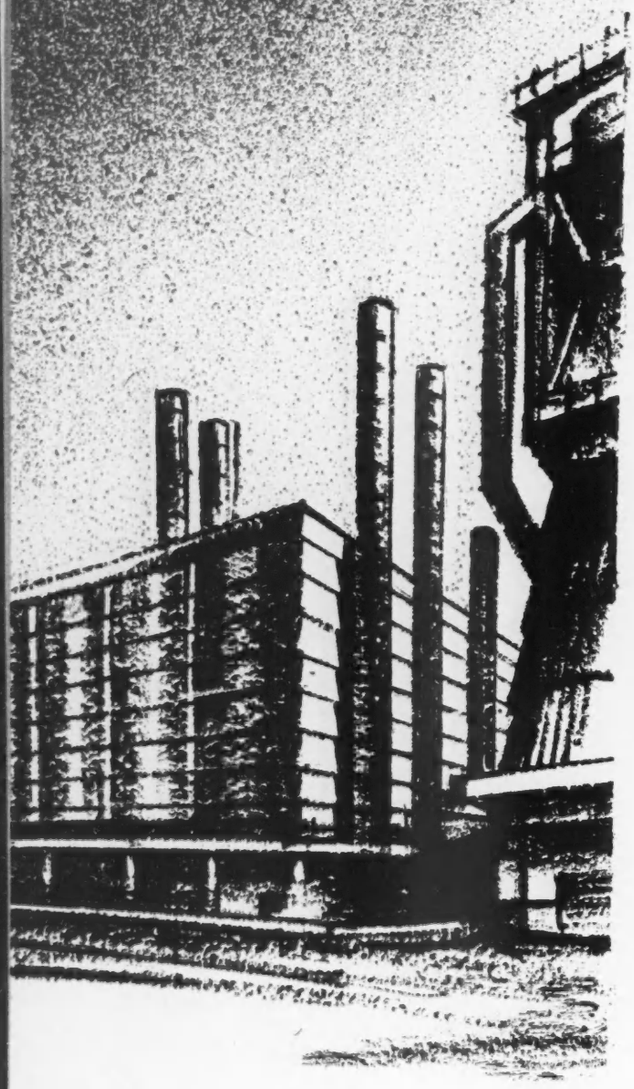
J. BLAKEBOROUGH & SONS LTD BRIGHOUSE ENGLAND



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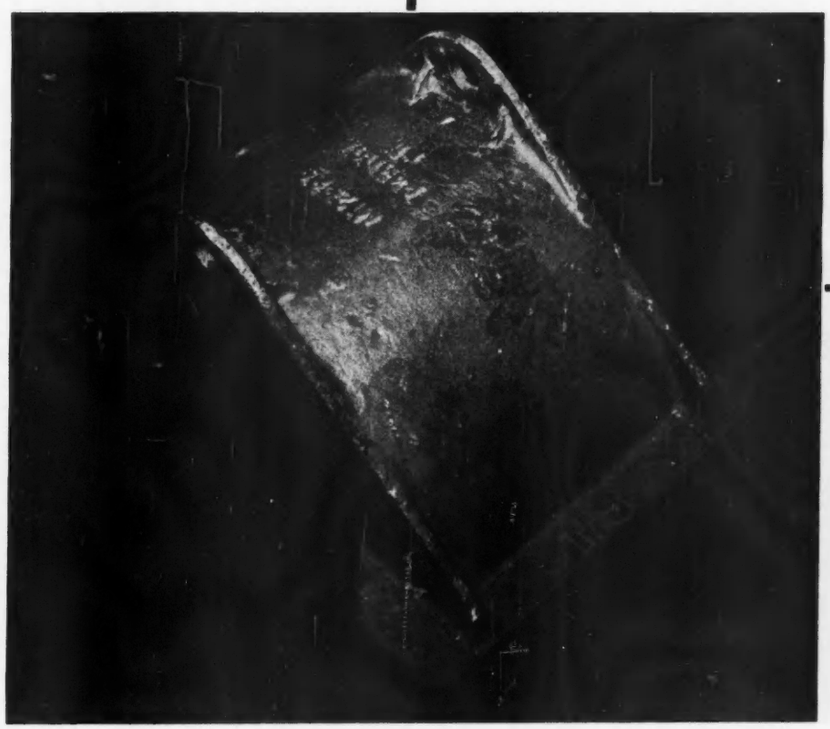
PARSONS turbo-blowers & turbo-generators

C. A. PARSONS & COMPANY LIMITED

HEATON WORKS · NEWCASTLE UPON TYNE · 6

cast in steel



at 14% less cost

– with greater rigidity and improved appearance

To reduce the cost of manufacture, whilst measuring up completely to the arduous conditions of service on Jones Cranes, this worm gearbox cover was remade as a steel casting in a modern steel foundry.

Compared with the previous method of production, this change gave a cost reduction of 14% on each cover, gave greater rigidity and, with the design freedom afforded by casting, gave improved appearance.

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ONE HOLE FREE IN EVERY THREE

The Speedicut "Chipbreaker" Drill operates at 50% to 400% higher feed rates, with the safety given by chip control. It will therefore drill at least three holes in the time normally taken for two.

We can demonstrate this to you on your own equipment.

There are real savings here, particularly as you also get more holes between regrinds.

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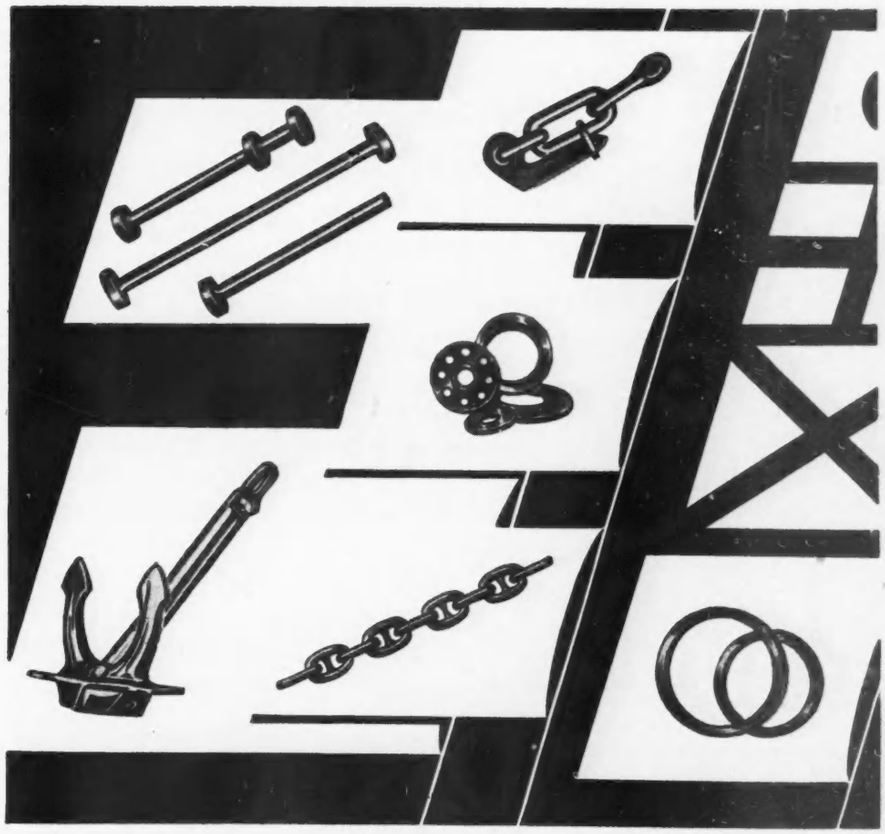

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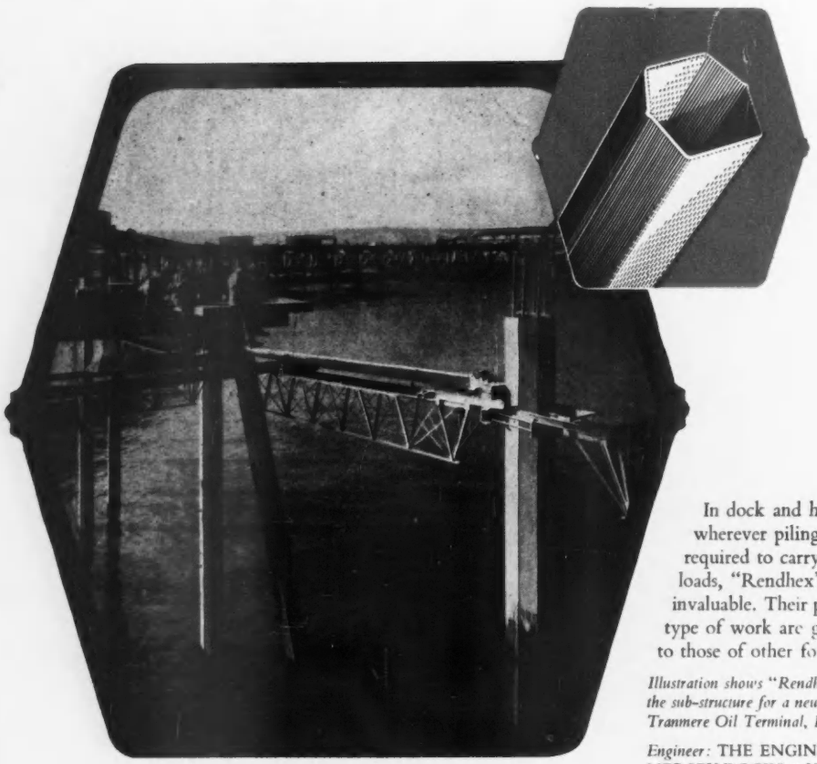
"RENDHEX" FOUNDATION COLUMNS



In dock and harbour installations, wherever piling construction is required to carry heavy vertical loads, "Rendhex" Columns are invaluable. Their properties for this type of work are generally superior to those of other forms of piling.

Illustration shows "Rendhex" Columns forming the sub-structure for a new oil tanker jetty at Tranmere Oil Terminal, Birkenhead.

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Contractors: PETER LIND & CO. LTD.

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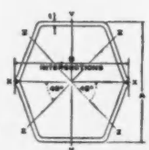

TABLE OF PROPERTIES

"Rendhex" Column No.	Size (Ins.)			Weight of Rolled Section lbs. per Lin. ft.	Weight of complete Col. (incl. Weld) lbs. per Lin. ft.	Area of complete Col. (excl. weld) Sq. ins.	Moment of Inertia (Ins.⁴)			Radii of Gyration (Ins.)			Section Moduli (Ins.³)		
	A	B	t				About XX	About YY	About ZZ	About XX	About YY	About ZZ	About XX	About YY	About ZZ
No. 3	13	12⅞	½	36·15	72.50	21·26	469·3	381·3	425·3	4·69	4·23	4·47	72.20	58·70	57·30
No. 4	16	16⅛	½	58·30	117·75	34·30	1214	1038	1126	5·95	5·50	5·73	151·75	125·82	116·15
No. 6	20	20	0·7	80·70	162·80	47·47	2657·7	2203·5	2430·6	7·49	6·81	7·16	265·80	218·60	207·20

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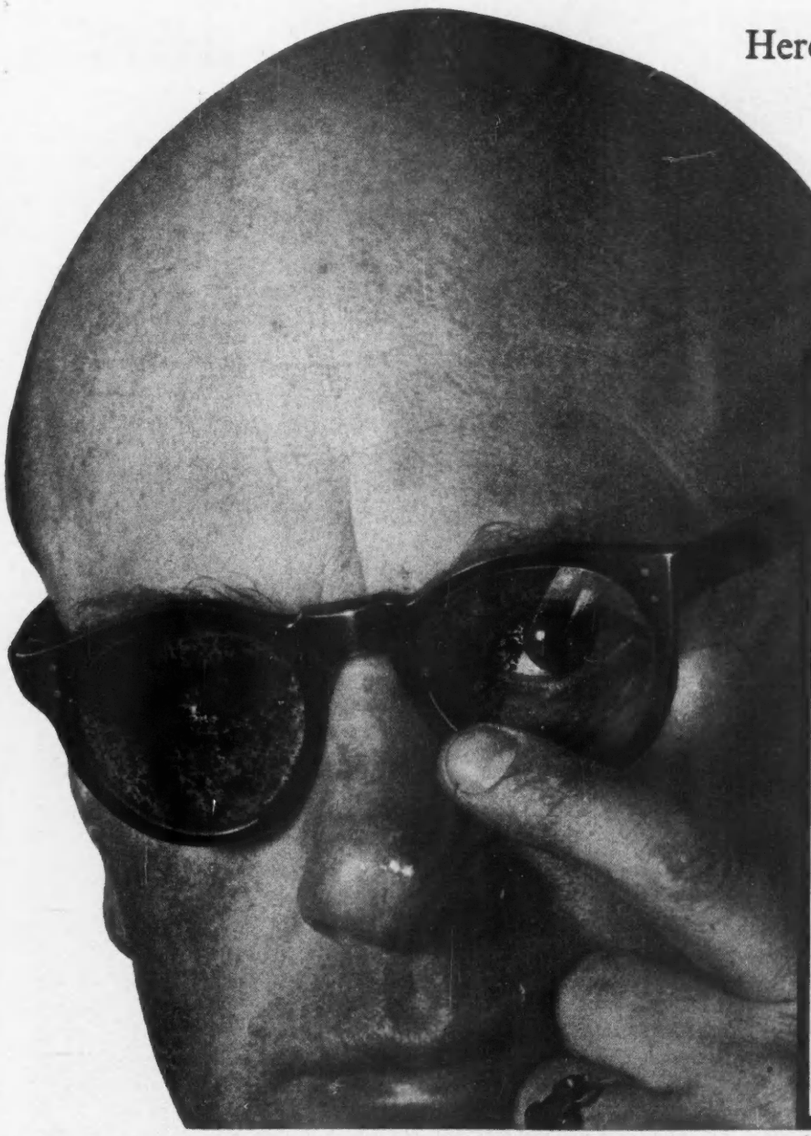

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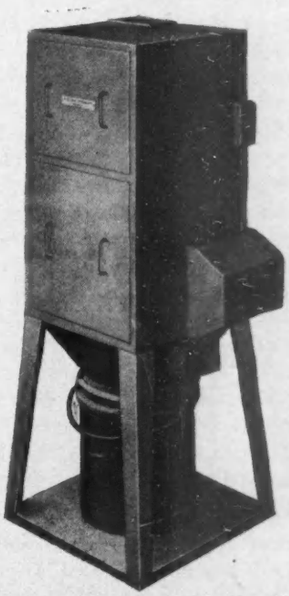

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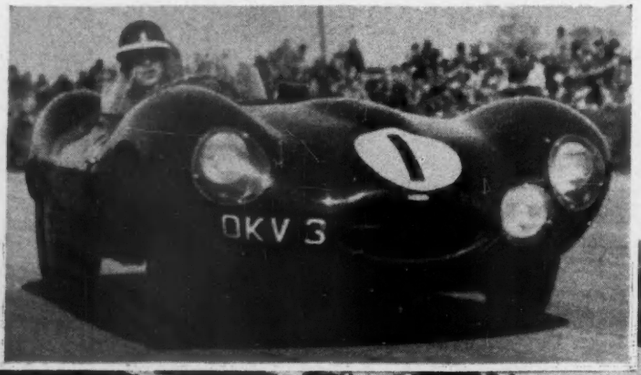
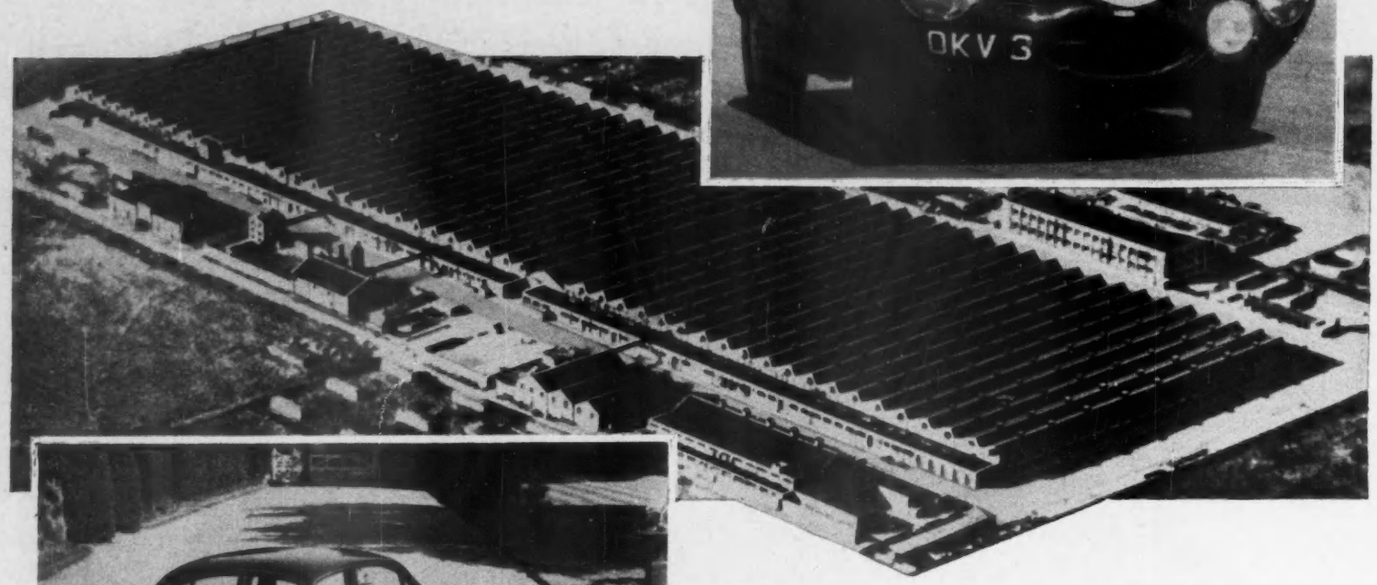


Mike Hawthorn (D Type Jaguar) at Silverstone

The Growth of an Enterprise



The Jaguar Mark 2 Saloon

"The West Midlands Gas Board kept their target with this new main to an extent which could not have been bettered by any other commercial organisation!"

The roots of the Jaguar organisation extend back for 38 years, when the present Chairman and Managing Director, Sir William Lyons, then Mr. Lyons, in company with a partner, started a modest factory for the manufacture of Swallow sidecars at Blackpool in 1922. By 1928 the Swallow Company had outgrown two factories and in that year moved to a large factory in Coventry. It was from that factory in 1931 that the first complete car made by the Company to have an identity of its own emerged under the name S.S. (Swallow Sports). In 1933 a new company was formed—S.S. Cars Ltd.—the original Swallow concern remaining in being, and in 1935 the first Jaguar saloon was introduced. Two-seater sports cars were added to the range—the Company being the first to produce a 100 m.h.p. regular series production car at a price of under £450.

The War, of course, called a halt to the progress of all motor car manufacture and in 1945 the newly named Company—Jaguar Cars Ltd.—set out with the primary object of raising the prestige of the British Car Industry abroad. It did this by combining exceptional technical design and high performance with near-perfect finish. In the years following the War, official Jaguar teams and private owners have won over 80 major international races and rallies and acquired hundreds of successes in the lesser national and international events. The fact that the Jaguar name has been blazoned across the World is confirmed by the fact that in the post-war years 56.9% of Jaguars went abroad, and no less than 48.2% captured the American market.

The total number of workpeople employed in the Jaguar factory is now 4½ thousand and the Company occupies a 78-acre site in Coventry. Open competition successes have placed the efficiency of the power and transmission systems of the Jaguar beyond reproach, but for the average motorist a high standard of finish which combines excellence in appearance with almost complete resistance to corrosion is just as important. The visitor to the factory cannot help but be impressed with the care taken on the finishing lines. A newly installed plant takes the car body on a huge spit through water rinsing, cleaning, phosphating and a chromic acid rinse. After drying, the body is dipped in a slipper paint bath to protect the innumerable nooks and crannies underneath, and then the surfacer coats are applied. Thus every car is adequately protected from corrosion. The protected bodies now pass on over-head conveyors through the remainder of the plant. The first operation is to spray sound deadener and sealing composition on the under side and then come rubbing down, the application of the sealing coat, and the final colour coats. During the whole of this time the car body remains on its mobile spit.

The complete sequence of finishing operations is as follows:—

1. Remove any oil from body.
2. Metal preparation and fittings.
3. Apply catalyst filler to holes in the lead loaded areas.
4. Transfer body to overhead dual conveyor.
5. Clean and phosphate body in 6-station spray phosphating plant, using low temperature process.
6. Dry in dry-off oven—temperature 320°F.
7. Apply synthetic stopping as required.
8. Tac rag.
9. Slipper dip lower half of body.
10. Drain and flash off.
11. Spray primer surfacer single and double header coats using Ecco 30 spray gun.

12. Stove for 45 minutes at 275/280°F.
13. Unload body from conveyor on to mobile spit.
14. Spray bituminous compound for sealing and sound deadening on the underside of the car and in the engine compartment.
15. Remove sound deadener overspray.
16. Wet wipe—320 paper.
17. Spin body to remove surplus water—dry off in oven at 265°F.
18. Spray one double header coat of sealer using Ecco No. 30 spray gun.
19. Bake sealer coat 30 minutes—270/286°F.
20. Wet face sealer coat with 400 paper. Spin body to remove surplus water and sponge down.
21. Dry off in oven ten minutes at 225/230°F.
22. Vacuum clean trestle.
23. Tac rag interior surfaces and exterior.
24. Spray door shuts, engine compartment and boot interior in colour.
25. Remove overspray from exterior, solvent wipe and tac rag exterior of body complete.
26. Spray one single and one double header coat of colour.
27. Bake colour coat 45 minutes at 250/265°F

Throughout these sequences the drying and stoving time schedules are vitally important. The gas-fired ovens used in operations 6, 12, 17, 19, 21 and 27 are held under a strict automatic temperature control by control pyrometers which instantly adjust the air and gas flow to ensure that the correct temperature is maintained.

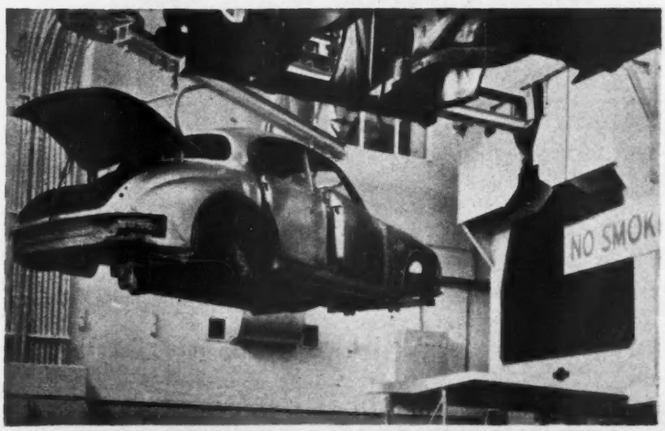
The Final Line

Town gas is also employed in other parts of the plant for numerous heat treatment purposes including annealing and carburizing. These heat treatment operations are, of course, also vitally important to the ultimate performance of the gearing and transmission. The correct time/temperature schedules to introduce the necessary metallurgical structure in the metals are also achieved by control pyrometers in the furnaces, regulating the air and gas supply according to requirements.

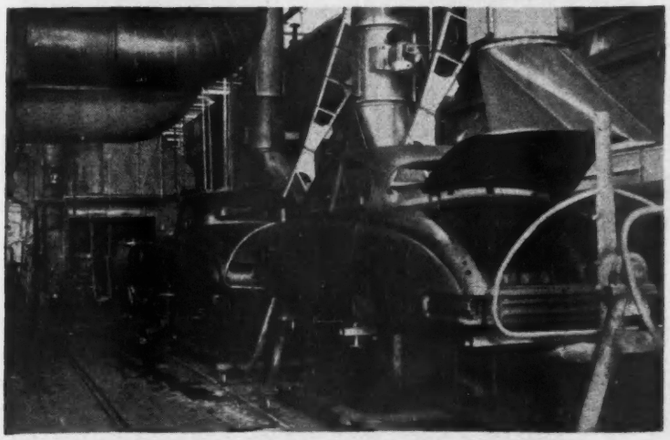
When the recent extension of the Jaguar factory was completed it was a formidable task of re-organisation, because it was essential that production disturbances should be a minimum.

Such was the increased demand for town gas that the West Midlands Gas Board had to lay on a new high pressure gas main. Executives of the West Midlands Gas Board and Jaguar Cars collaborated closely to maintain the target they had set themselves, and those at Jaguars' commented, "*The West Midlands Gas Board kept their target with this new main to an extent which could not have been bettered by any other commercial organisation!*"

Motor car manufacture is, of course, but one of the thousands of trades, professions and occupations which employ town gas in those production techniques where an automatic heat service is a paramount necessity. Each of the twelve Area Gas Boards throughout the country employs specialised industrial gas engineers, which have studied the many varied techniques of industrial gas application. Industrial gas executives from each of the Area Gas Boards meet regularly to interchange experiences and discuss new problems which have been presented to them. The result is that any industrialist making an approach to any Industrial Officer at any Area Gas Board has presented to him immediately an overall picture of the latest techniques of heat control, based upon progress made throughout the country—and in addition, the Industrial Gas Information Bureau keeps in close touch with developments in industrial gas usage throughout the World.



Rustproofing of the Body



The Paint Shop

Scottish Gas Board, Edinburgh
Northern Gas Board, Newcastle-upon-Tyne
North Western Gas Board, Manchester
North Eastern Gas Board, Leeds
East Midlands Gas Board, Leicester
West Midlands Gas Board, Birmingham
Wales Gas Board, Cardiff
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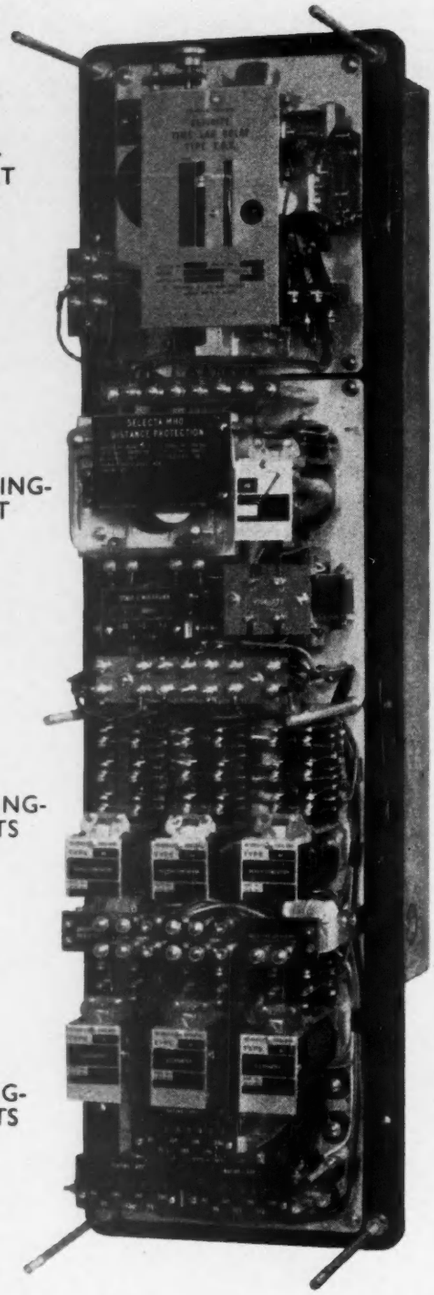

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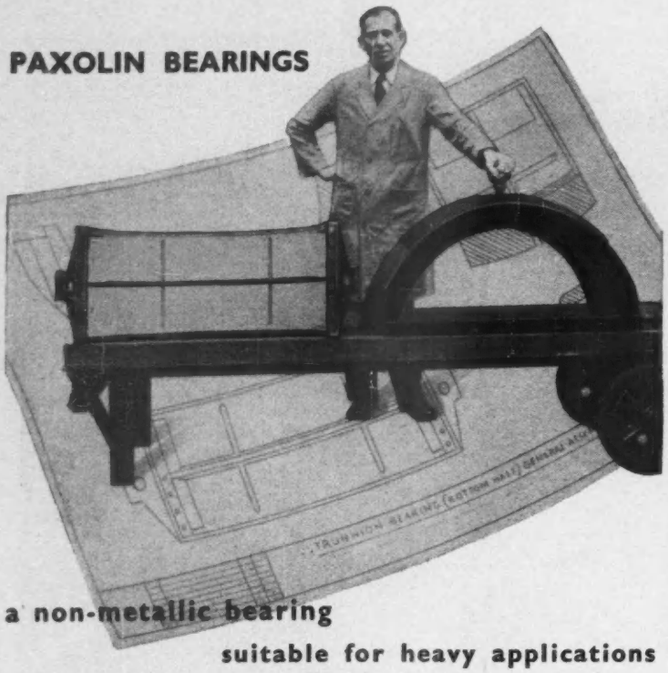

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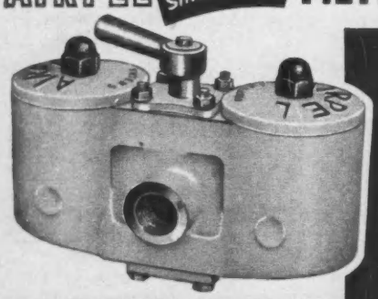

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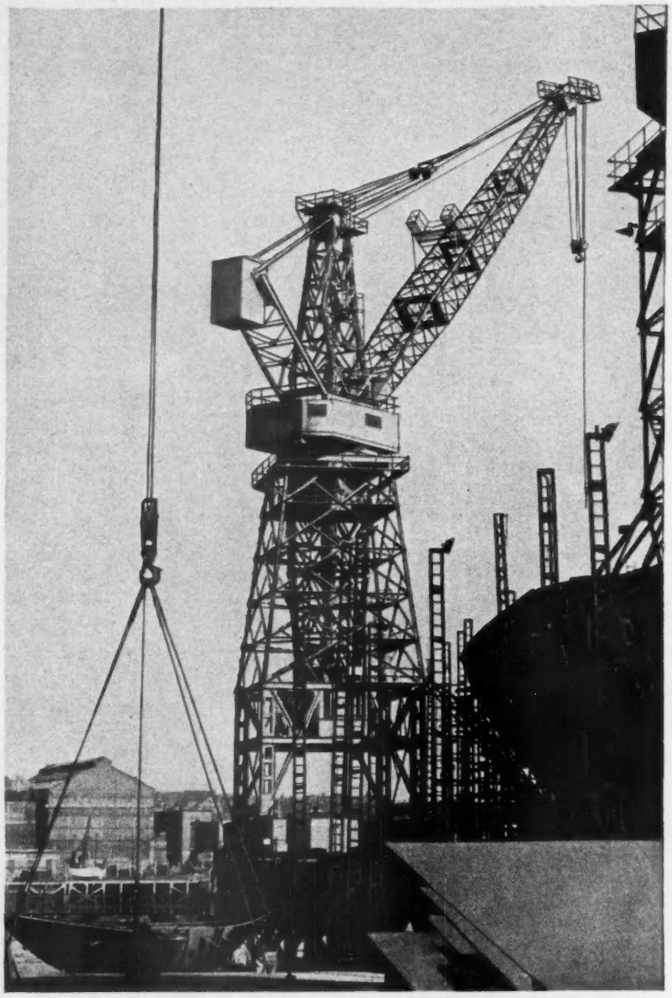

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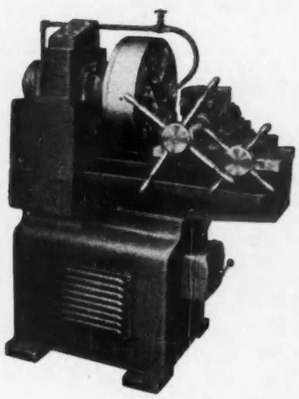

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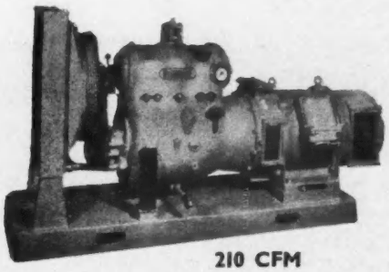

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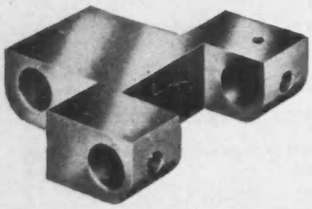

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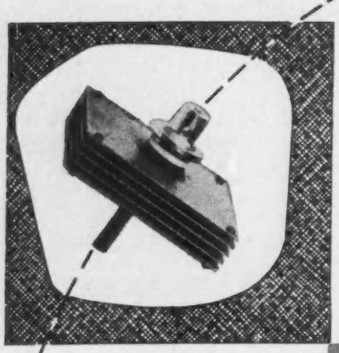

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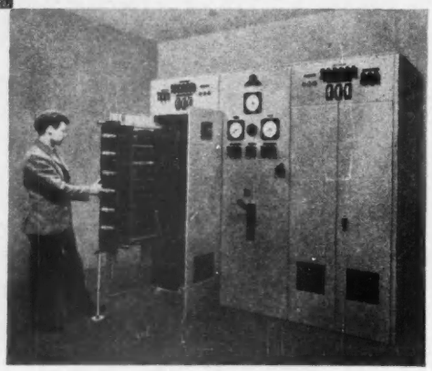

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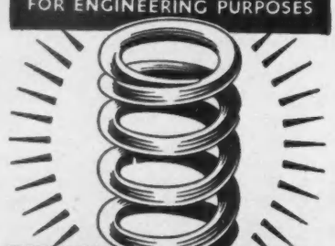

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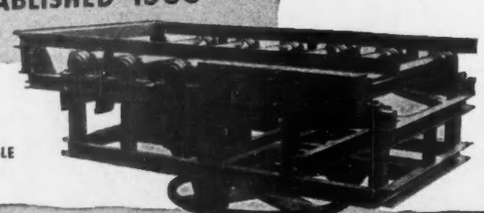

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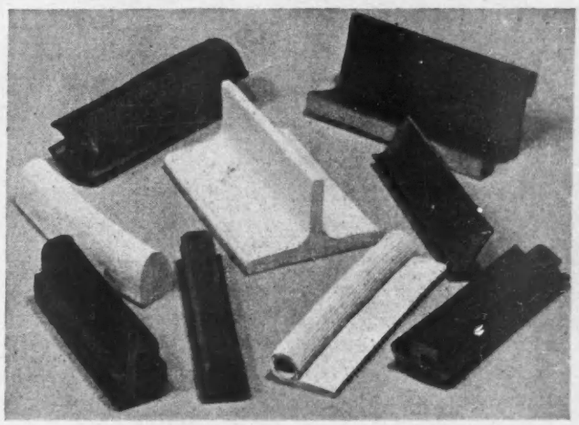

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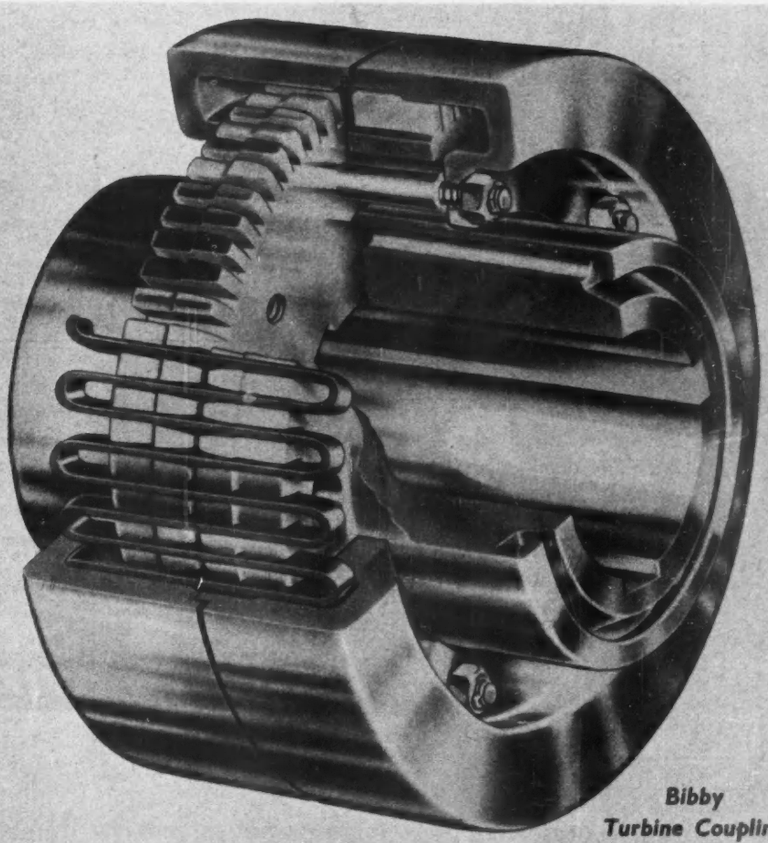

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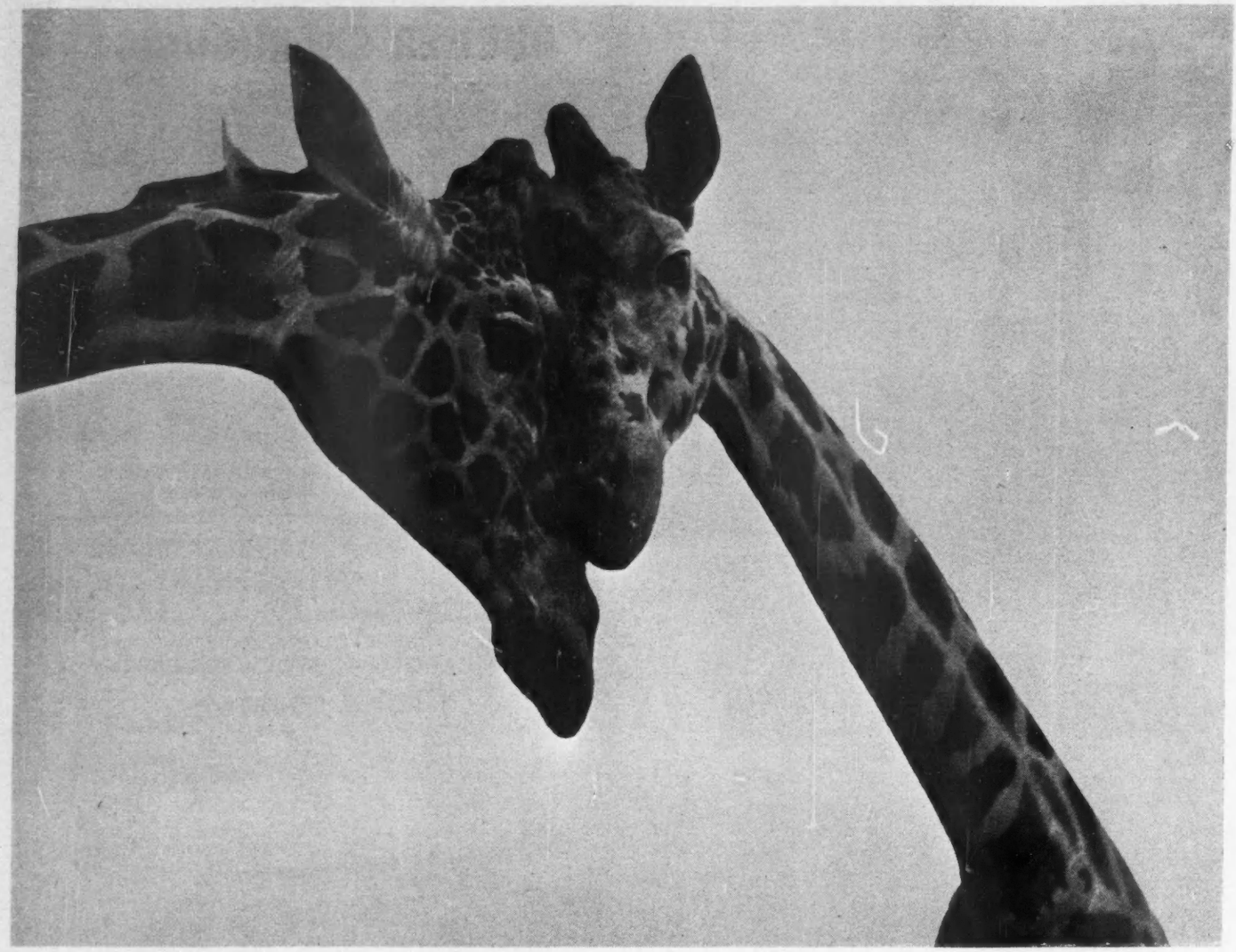

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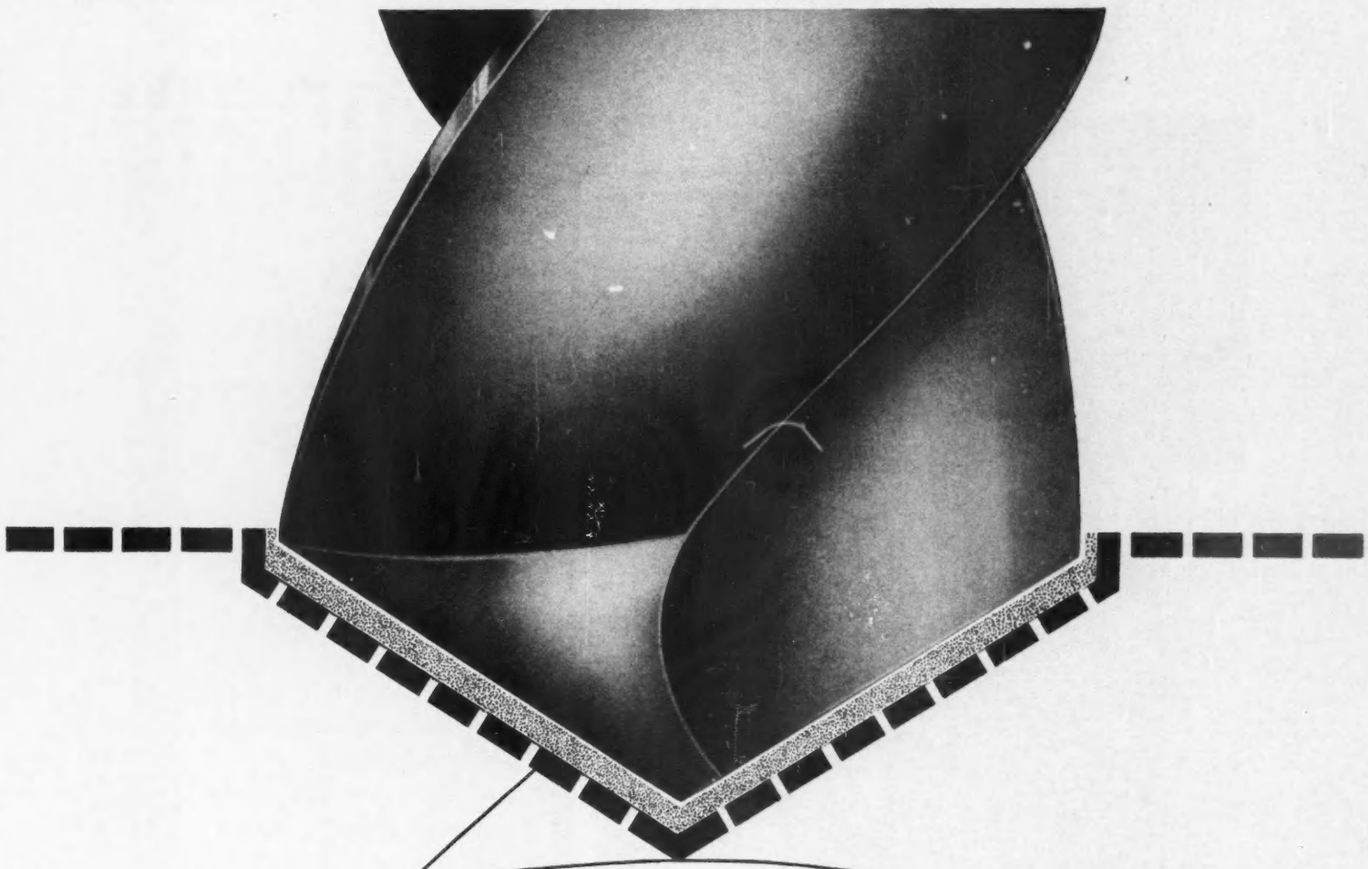

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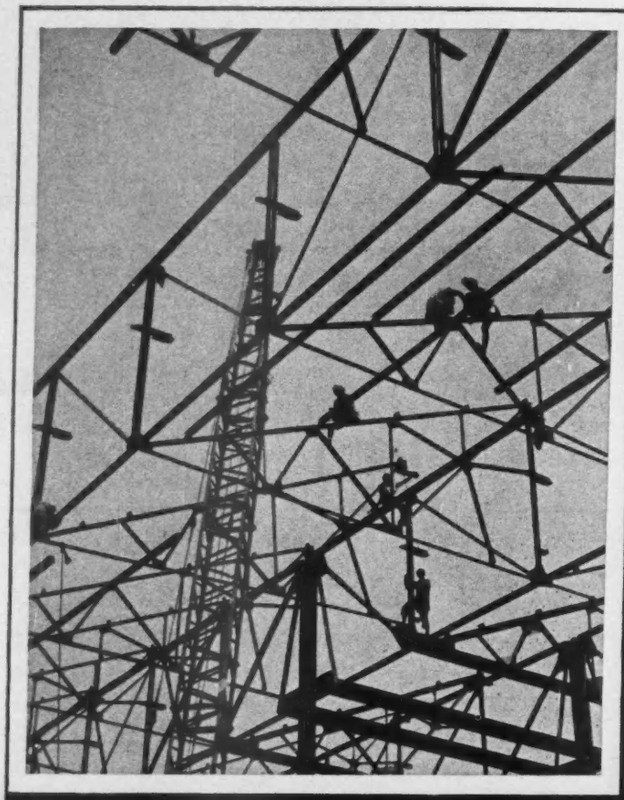

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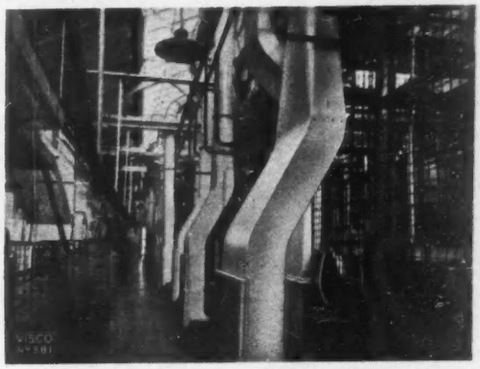

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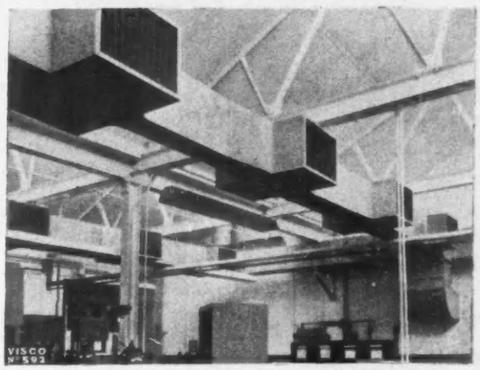

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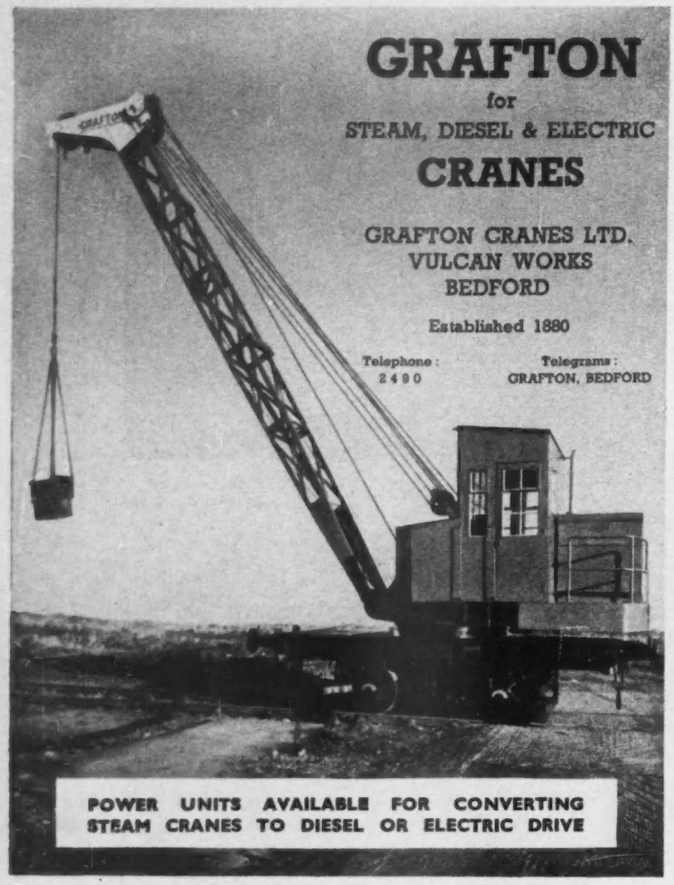

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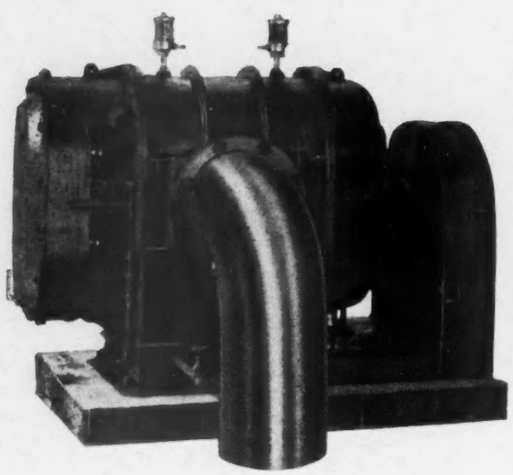

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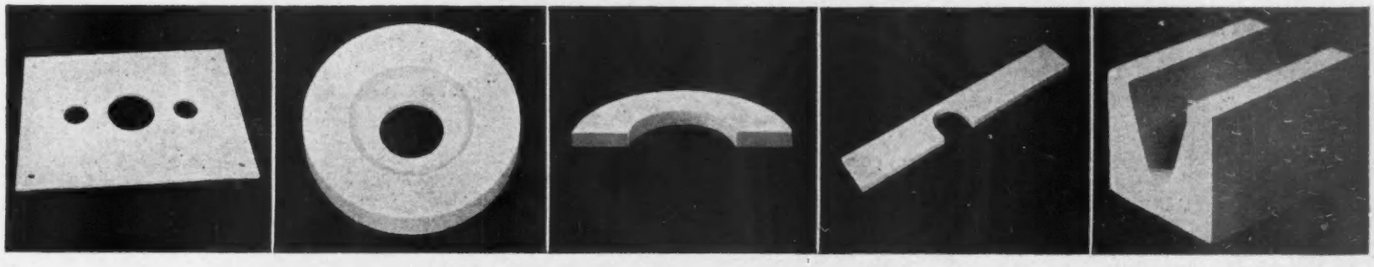

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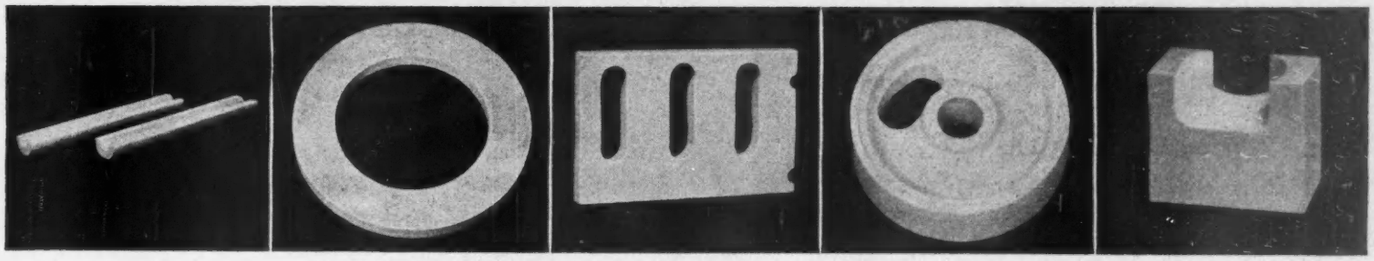

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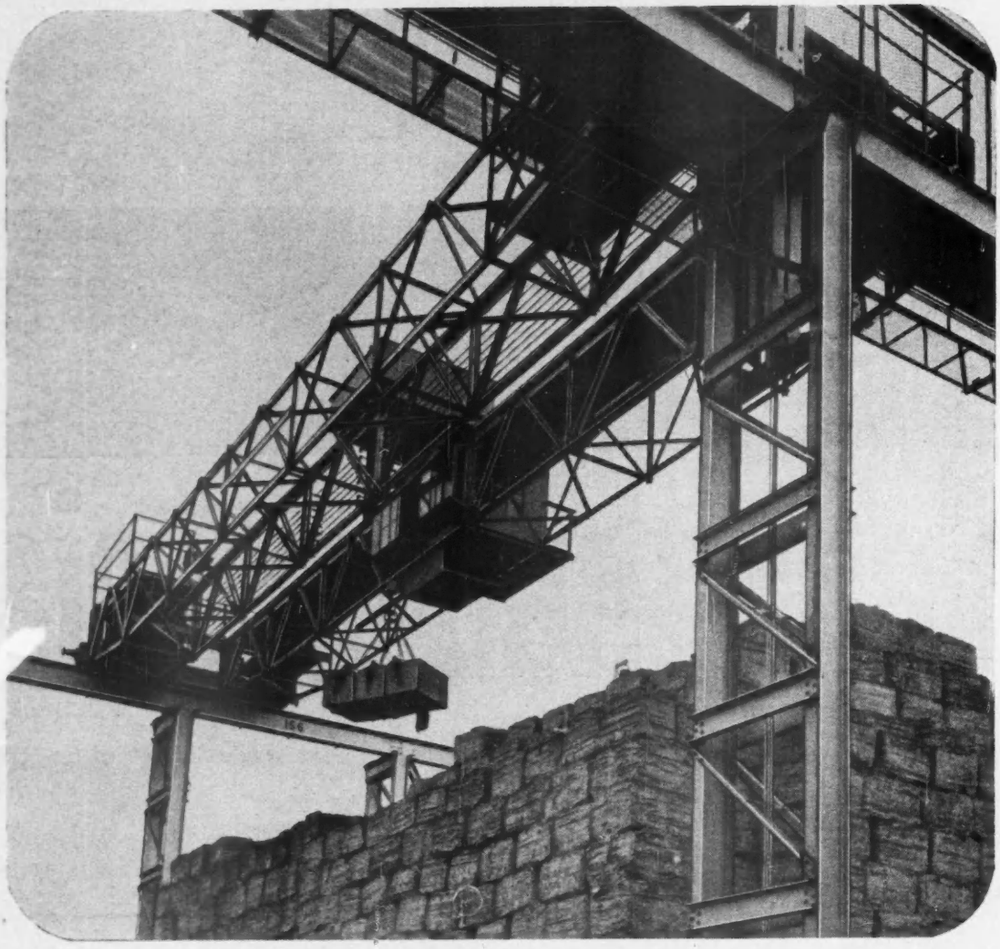

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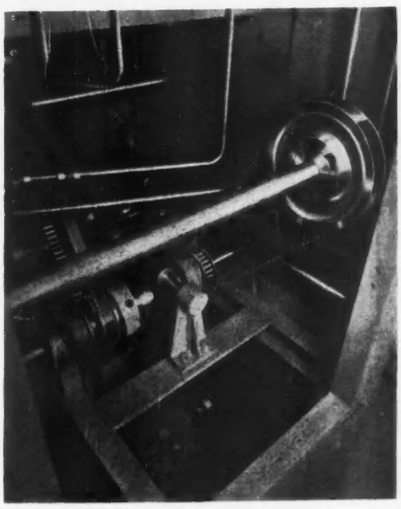

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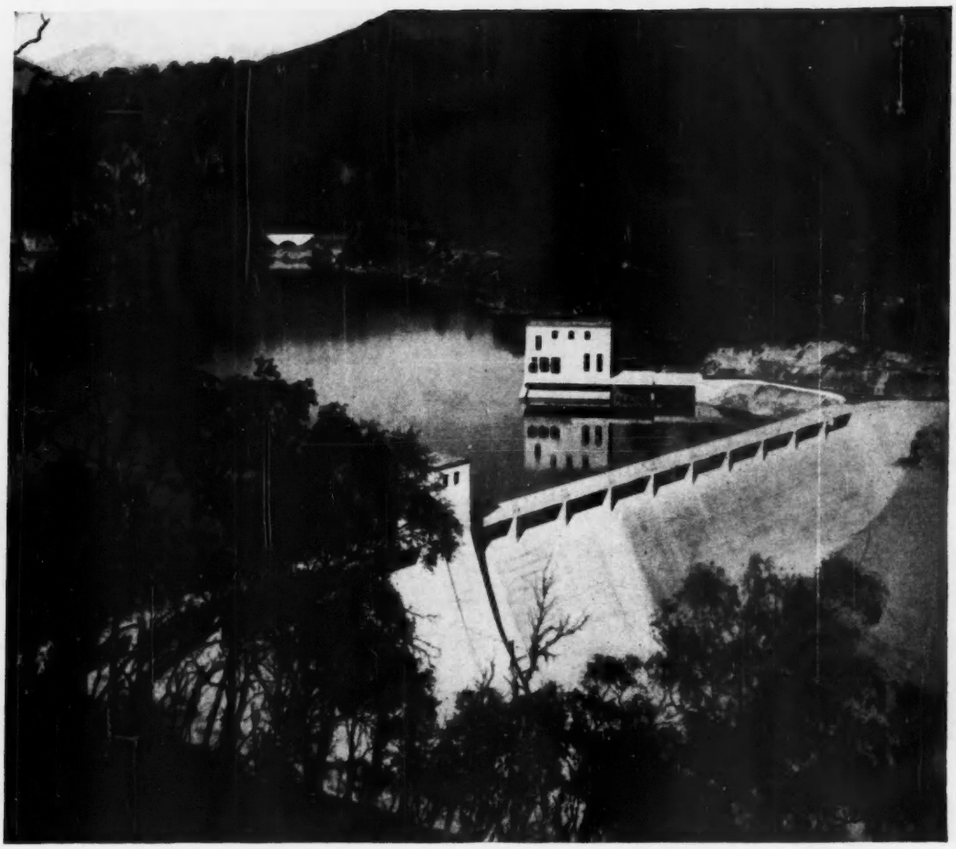

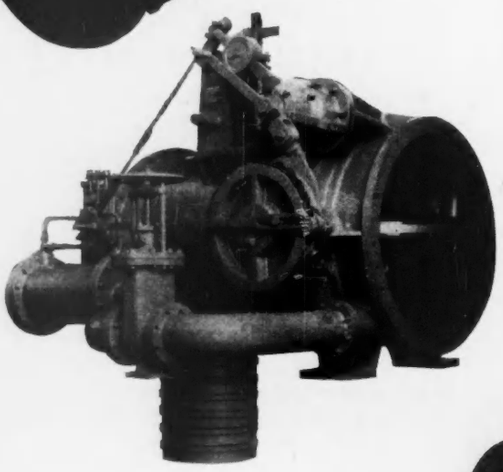

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